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# WATER RESOURCES OF NORTH CAROLINA

# CHOWAN RIVER BASIN

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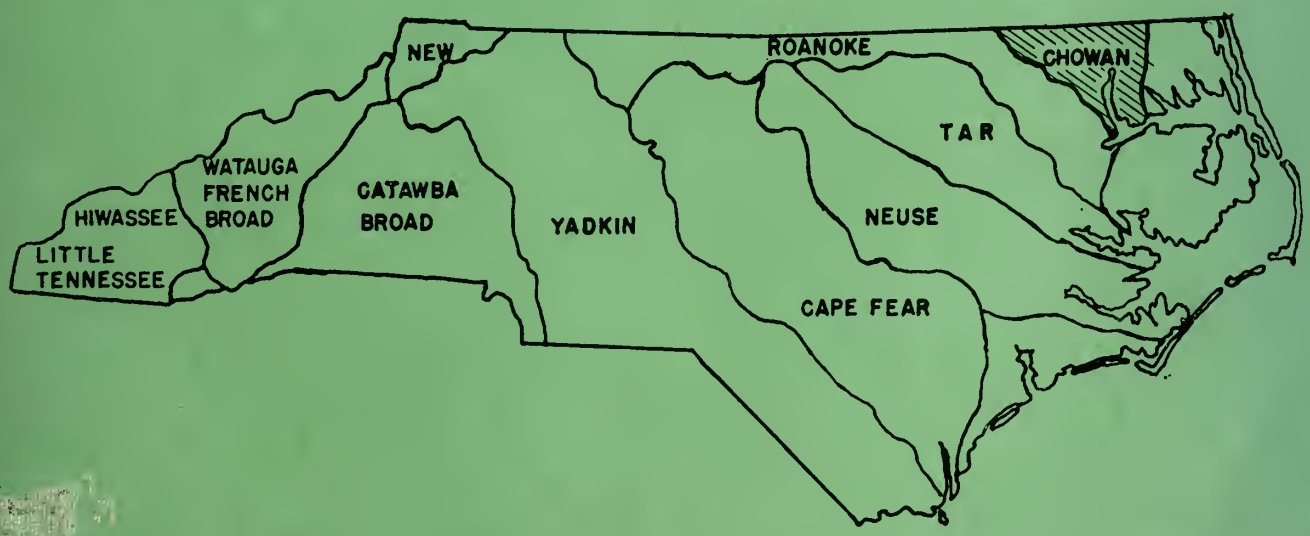


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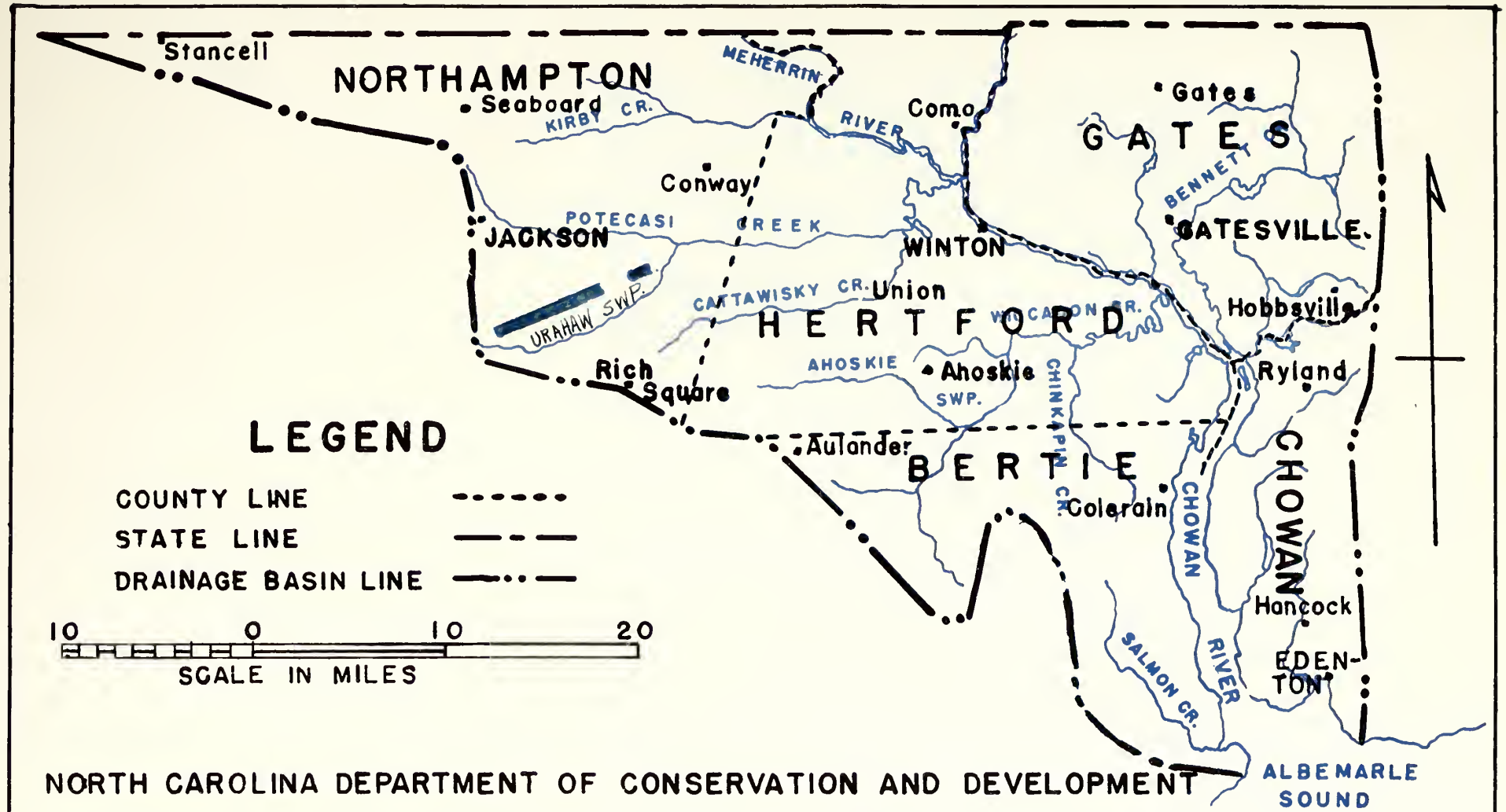


NORTH CAROLINA DEPARTMENT OF CONSERVATION AND DEVELOPMENT

DIVISION OF WATER RESOURCES, INLETS AND COASTAL WATERWAYS

# MAP OF CHOWAN RIVER BASIN

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# FOREWORD

This publication comprises Volume IV of a series of eleven volumes, containing information regarding the water resources of North Carolina. Volume I, pertaining to the State as a whole, was published in January 1955; Volume II, covering the Neuse River Basin, was published in May 1955; and Volume III, containing information regarding the Yadkin-Pee Dee River Basin, was published in August 1955. Volumes V-XI, inclusive, will provide an inventory of the water resources of the French Broad-Pigeon, Roanoke, Cape Fear, Tar-Pamlico, Catawba-Broad, Hiwassee-Little Tennessee, and New-Watauga River Basins. When the contemplated series are completed, information for the entire State will be available to assist in the orderly planning and development of the water facilities required for municipal and industrial expansion, and for the expansion of the uses of water in agriculture; to guide watershed authorities, basin associations, soil conservation districts, and other agencies concerned with water uses in accomplishing their purposes; and to provide aid to the Board of Water Commissioners of the State of North Carolina, created by the 1955 Session of the General Assembly of North Carolina.

It is hoped that this publication will assist in the location, development, and expansion of municipal, industrial, agricultural, and other water supplies, and will serve as a guide to the future study of water resources in the Chowan River Basin.

662335

# BIBLIOGRAPHY

Material from House Document No. 101, 76th Congress, 1st Session was used in Chapters I and XI.

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Chapter XII includes material from a report of the District Engineer Norfolk District, Corps of Engineers, U. S. Army, dated January 22, 1879; House Document No. 1114, 62nd Congress, 3rd Session; "Water Resources Development by the Corps of Engineers in North Carolina", Office of the Division Engineer, South Atlantic Division, Corps of Engineers, U. S. Army, Atlanta, Georgia, January 1, 1955; and "Water Resources Development by the Corps of Engineers in Virginia", North Atlantic Division, Corps of Engineers, U. S. Army, January 1, 1955.

The valuable cooperation of the Federal and State agencies which have contributed to the preparation of this publication is gratefully acknowledged.

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## CHAPTER I - DESCRIPTION OF WATERSHED

Names and locations of Main Stream and Tributaries - The Chowan River is an interstate stream having its source in Virginia and draining into the west end of Albemarle Sound in North Carolina. It has a total drainage area of 4,860 square miles lying in the States of North Carolina and Virginia. The drainage area of that portion lying within the State of North Carolina, including Edenton Bay and the waters adjacent to the mouth of the river, is 1,262 square miles.

The Chowan River is formed by the confluence of two Virginia rivers, the Nottoway and Blackwater Rivers. This confluence occurs in Hertford County about 1.5 miles south of the North Carolina-Virginia State Line. Its principal tributaries, in addition to the source tributaries, are the Meherrin River, Wiccacon River, and Bennetts Creek. Its drainage basin is bounded on the north and east in Virginia by the James River Basin, on the east in North Carolina by the Pasquotank River Basin, and on the west and south by the Roanoke River Basin. It flows principally through low swamp areas, from the confluence of the Nottoway and Blackwater Rivers in a generally southerly direction about 52 miles to the west end of Albemarle Sound, forming successively the Hertford-Gates, Hertford-Chowan and Bertie-Chowan County Lines.

It has a drainage area of 4,860 square miles. The width between banks at the mouth is 2.75 miles; at U. S. Highway 17 bridge, 2.0 miles above the mouth, 1.05 miles; at Colerain, 14 miles above the mouth, 1.7 miles; at the mouth of Bennetts Creek, 32 miles above the mouth, 0.8 mile; at the Atlantic Coast Line Railroad Bridge at Tunis, 34 miles above the mouth, 1,320 feet; at the mouth of Meherrin River, 40 miles above the mouth, 1,200 feet; and at the confluence of its two source tributaries, 400 feet. Chowan River carries very little sediment, and its currents are slight, except during freshets. Its surface is subject to slight, irregular fluctuations caused by winds, reaching from one to two feet above and below the mean low water plane. Due to its width, flood discharges from its tributaries cause only slight, irregular fluctuations. The maximum and minimum discharges of the river are unknown, and its low -water slope is negligible. It is navigable for its entire length.

Chowan River has never been improved by the United States. A chart of the river, published by the Coast and Geodetic Survey, shows a controlling depth of 14 feet between its mouth and the mouth of Meherrin River. A survey in 1938 of the Chowan River between the mouth of the Meherrin River and the confluence of the Blackwater and Nottoway Rivers showed a controlling depth of 11 feet at low water. This depth was found at mile 48.8, or 8.8 miles above the mouth of Meherrin River. Contrary to reports of local interests, no shoal was found opposite Dowry Island. Navigation aids are maintained in Chowan River for a distance of 16 miles above the mouth.

The Blackwater River is a non-tidal fresh-water stream, having its source in Virginia about 22 miles southeast of Richmond. It is sluggish and tortuous, flowing southeast and south about 80 miles through low and swampy terrain to its confluence with the Nottoway River. The water is of the dark color characteristic of the swamp streams in this locality, and carries very little sediment. From its source to its mouth, it traverses the county of Prince George and successively forms the boundary of Surry, Sussex, Isle of Wight, Southampton, and Nansemond Counties. It has a drainage area of 700

square miles. It has no important tributaries but is fed by numerous small branches. The width between banks at its mouth is 250 feet; at Franklin, 120 feet; and at Burdette, the established head of navigation, about 100 feet. Above this point, the width is generally less than 100 feet, narrowing to a few feet at its source.

The surface of Blackwater River is subject to irregular fluctuations of from one to two feet above or below mean low water, for periods of three to four days at a time, under the influence of winds in Albemarle Sound. Prolonged rains cause rises of from three to four feet at Franklin, but they are of short duration, and result only in the flooding of adjacent timber and swamp lands. Freshets cause little, if any, variation in level at the mouth. The low-water slope of its navigable portion is negligible. The head of navigation for practicable purposes is at Burdette, 25 miles above the mouth, but the fixed highway and railroad bridges at Franklin, 14.7 miles above the mouth, would prevent the passage of any craft ordinarily used in river commerce.

The Nottoway River rises in Virginia about 50 miles southwest of Richmond. It flows southeasterly, then northeasterly to a point about 15 miles southwest of the source of the Blackwater River, and thence southeasterly to its confluence with the Blackwater River. Further information regarding the Nottoway River is not available. No mention of it is found in "Water Resources Developments by the Corps of Engineers in Virginia, North Atlantic Division, Corps of Engineers, U. S. Army, New York, N. Y., 1 January 1955".

The Blackwater, Nottoway, and Meherrin Rivers, all of which originate in Virginia, drain the portion of the Chowan River lying in Virginia.

The Meherrin River rises in Virginia about 28 miles north of Clarksville, flows east and southeast, enters North Carolina from Virginia at the point of intersection of N. C. Highway 195 with the North Carolina-Virginia State Line, flows about five miles in the northeastern part of Northampton County, returns to Virginia about three miles east of its first entrance into North Carolina, re-enters North Carolina about five miles east of its first entrance, flows south and northeast in North Carolina to a point on the North Carolina-Virginia State Line about seven miles east of its first entrance, forms the Northampton-Hertford County Line to a point about two miles north of Murfreesboro and in Hertford County flows to the northern boundary of Murfreesboro and thence easterly and southeasterly to its confluence with the Chowan River on the Hertford-Gates County Line about three miles slightly northwest of Winton. The Meherrin River has a total drainage area of 1,616 square miles of which 478 square miles are in North Carolina. The principal tributary of Meherrin River is Potecasi Creek, which rises in Northampton County about two miles southeast of the Town of Seaboard, flows southeast and east until it crosses the Northampton-Hertford County Line about four miles northeast of the Town of Woodland, and flows east and northeast in Hertford County to its confluence with the Meherrin River about 0.6 mile west of the confluence of the Meherrin River with the Chowan River.

The Wiccacon River rises in Hertford County about 0.5 mile southwest of Cofield, located on the Atlantic Coast Line Railroad about 2.5 miles southwest of this railroad's bridge across the Chowan River near Tunis. The principal tributary of the Wiccacon River is Ahoskie Creek, which rises on the Hertford-Bertie County Line about four miles west of the intersection of N. C. Highway 305 and the Hertford-Bertie County Line, and flows in Hertford County,

north, east, southeast, northeast, and north to its confluence with Wiccacon River about six miles west of Harrelsville.

Bennetts Creek rises in Gates County about 2.5 miles northeast of Hobbsville and flows to Sunbury, about six miles north of Hobbsville, and thence west, southwest and southeast to its confluence with the Chowan River about six miles southwest of Hobbsville.

Drainage Areas - The Following table shows the total area of the five North Carolina counties lying wholly or partially within the Chowan River Basin, the approximate area of each county drained by the Chowan River, and the percentage of each county lying within the basin.

| County | Area (sq. mi.) | Estimated Area in Basin (sq. mi.) | Percent within the basin |
|---|---|---|---|
| Bertie | 682 | 190 | 28 |
| Chowan | 180 | 110 | 61 |
| Gates | 340 | 262 | 77 |
| Hertford | 345 | 345 | 100 |
| Northampton | 541 | 355 | 66 |
| Total | 2,088 | 1,262 | |

Topography - That part of the Chowan River Basin which is in North Carolina lies entirely within the Coastal Plain area. The highest land elevation in the basin is 350 feet in Northampton County near Vultare. The mouth of the river, where it enters Albemarle Sound, is at sea level. The slope of the Meherrin River in North Carolina is less than one foot per mile. The Chowan River itself has practically no slope, it being nearly at sea level between the mouth of the Meherrin River and Albemarle Sound. In general, the land in the Chowan River Basin is level, with large portions being low and swampy.

Cover and Climate - Sixty per cent of the land is classed as forest. Pasture and cropland cover about 27 per cent of the area, while swamp and woodlands account for most of the remaining area.

The mean annual temperature of the five counties which make up the basin is approximately 60 degrees Fahrenheit, with the January average falling as low as 42 degrees Fahrenheit in some sections and the July average rising as high as 90 degrees Fahrenheit in others. The average growing season (number of days between last killing frost in the spring and the first killing frost in the fall) is between 196 and 217 days. The average annual rainfall ranges between 41 and 51 inches, with the highest monthly averages falling between June and September.

Population - The population and growth of North Carolina cities and towns within the Chowan River Basin that have populations in excess of 1,000 are set forth in the following table:

| Community | 1940 | 1950 |
|---|---|---|
| Edenton | 3,835 | 4,468 |
| Ahoskie | 2,313 | 3,579 |
| Murfreesboro | 1,550 | 2,140 |
| Aulander | 1,057 | 1,112 |

The population and growth of counties within or partially within the basin are as follows:

| | 1940 | | 1950 | |
|---|---|---|---|---|
| | Within Basin | Total | Within Basin | Total |
| Bertie | 7,340 (est.) | 26,201 | 7,500 (est.) | 26,439 |
| Chowan | 7,060 (est.) | 11,572 | 7,650 (est.) | 12,540 |
| Gates | 7,750 (est.) | 10,060 | 7,360 (est.) | 9,555 |
| Hertford | 19,352 | 19,352 | 21,453 | 21,453 |
| Northampton | 18,680 (est.) | 28,299 | 18,770 (est.) | 28,432 |

Industries - There are comparatively few industries in the Chowan River Basin, and most of them are small. The North Carolina Directory of Manufacturing Firms for 1952 lists a total of 106 firms for the five counties in the basin. Of these firms, over 82 per cent have less than 50 employees, and only one has over 250 employees. Lumbering and wood-products manufacturing (other than the making of furniture) account for 72.6 per cent of these business organizations. Sixteen per cent of the firms are engaged in food processing and allied concerns, leaving 11.4 per cent to be distributed among all other types of industry. The 1950 census lists 4,834 people (4.9 per cent) engaged in manufacturing in these five counties.

Electric Power - Because of the lack of elevation, there are no power developments of any kind in the Chowan River Basin within North Carolina. There are a few small mill dams that have been constructed for power use on some of the tributaries of the main stream.

Geology - The Chowan River Basin in North Carolina lies in the tertiary formation, which consists of four formations known from the oldest to the youngest as Castle Hayne, Trent, Yorktown, and Waccamaw. The Yorktown formation occupies the northern half of the Coastal Plain west of a line from Edenton to New Bern. This formation is composed mainly of sands, clays, and marl beds. The sand is fine grained and often bluish-gray to dark bluish-green in color when fresh. It fades to a light gray or yellow on exposure to the air. Sandy marls, containing an abundance of shells and shell fragments make up an important part of the formation.

Most soils in this area are deep, and have a medium to somewhat fine texture. Silt-loam surface-soils and silty-clay-loam subsoil textures are common because of the large areas of fine-textured geologic materials. Due to poor drainage, both surface and subsoil colors are dark. Upland bogs are composed of brown peats or black mucks which are partly due to completely-decomposed plant remains.

Common brick clay has been found in the area, and one brick plant is now operating. One oil well has been drilled in Hertford County without success, as is the case with other wells drilled in the Coastal Plain area to date. Even though oil and gas have not been found, the thickness and character of the sedimentary beds found along the coast make the area interesting for further search.

Forest Resources - Though there are no pulp mills in the Chowan River Basin, the harvesting of both pine and hardwoods is an important source of income. In 1952, the five North Carolina counties in the Basin harvested 40,342 standard cords of pine and 4,539 cords of hardwoods for a total of

44,881 cords, or almost 3.4 per cent of the total pulpwood harvested in the State.

The 1945 Forest Resource Appraisal of North Carolina states that 60 per cent of the land area of these counties is in forest. There are no National or Public Forest in the Basin, and farm woodlands account for 51 per cent of the total forest.

The following table, taken from Bulletin No. 53 of the State Department of Conservation and Development, shows the amount of lumber sawed in each of the counties in the basin.

| County | Total Forest Land, acres | % Total Land Area in Forest | Lumber Sawed 1000 bd. ft. 1942 |
|---|---|---|---|
| Bertie | 306,916 | 69 | 49,055 |
| Chowan | 47,232 | 41 | 24,246* |
| Gates | 161,567 | 74 | 4,115 |
| Hertford | 145,134 | 64 | 14,636 |
| Northampton | 174,182 | 50 | 35,356 |
| Total | 835,031 | | 127,408 |

*Total for Chowan and Perquimans Counties

Agriculture - Farming is diversified in the Chowan River Basin, and the main crops are tobacco, peanuts, corn, and cotton. Commercial truck farming is also important. The growing of livestock is increasing. At the present time, almost twice as many cattle are being raised for beef as are being raised for milk. In 1950, the average farm in these five counties contained 82 acres and had a value of $6,905. Approximately 58 per cent of the farms were tenant-operated, and approximately 60 per cent of them were wired for electricity. The number of all types of rural places reporting electricity in 1950 was 11,073. As of January 1, 1954, the number was 14,475, a gain of almost 31 per cent.

The following table lists the total value of the eleven principal crops grown in each county within the Basin. The crops considered are tobacco, cotton, peanuts, Irish potatoes, sweet potatoes, corn, wheat, oats, soybeans, lespedeza, and hay. These statistical data were taken from the 1953 issue of "North Carolina Agricultural Statistics".

| County | No. of Farms 1950 | Areas Harvested 1951 | Value of Products 1951 |
|---|---|---|---|
| Bertie | 3,138 | 113,520 | $15,293,590 |
| Chowan | 798 | 38,990 | 3,983,410 |
| Gates | 1,280 | 47,360 | 4,464,930 |
| Hertford | 1,945 | 73,510 | 10,063,450 |
| Northampton | 3,824 | 148,460 | 15,643,430 |
| Total | 10,985 | 421,830 | $49,448,810 |

Transportation - Quite naturally, much of the early transportation in the area was by water. Lately, however, an up-to-date system of modern, hard-surfaced roads has made access by car and truck not only a possibility but also a pleasure. The main north-south highways are U. S. Highways 13, 17,

and 258, and N. C. Highways 32, 45, and 305. U. S. Highway 158 is the main east-west artery. Many unnumbered, improved "farm-to-market" roads provide a complete east-west system and make school-bus service available to the large rural population. As of January 1, 1953, there were 2,122 miles of roads in the five counties, of which 1,132 miles were hard-surfaced.

The Chowan River can be crossed by automobile at only two points, the U. S. Highway 13-158 -- N. C. Highway 45 bridge, about two miles northeast of Winton in Hertford County, and U. S. Highway 17 bridge, about 3.5 miles west of Edenton near the mouth of the river. The lower portion of the Meherrin River is crossed by a free ferry (Parker's Ferry) near its mouth, connecting roads between Winton and Como. The upper portion of the river is crossed by a bridge on U. S. Highway 258 at Murfreesboro and a bridge connecting graded and drained roads in Northampton and Hertford Counties about one mile southeast of the North Carolina-Virginia State Line.

Information regarding river transportation may be found in Chapter XI of this publication.

Railroad transportation in the North Carolina portion of the Chowan River Basin is provided by facilities of the Atlantic Coast Line, Norfolk Southern, Seaboard Air Line, and Carolina Southern Railroads. Bus transportation is available to all of the main towns in the Basin. Edenton is the only town having an airport.

Chowan River Bridges - The following table sets forth characteristics of bridges crossing the Chowan River:

| Miles above mouth | Name | Use | Type of draw | Navigation opening | |
|---|---|---|---|---|---|
| | | | | Clear width normal to channel | Vertical clearance at mean low water |
| 2.0 | U. S. Hwy. 17 | Highway | Swing | 80 ft. | 8.5 ft. |
| 34.0 | A.C.L.R.R. | Railroad | Swing | 54 ft. | 9.0 ft. |
| 36.5 | U. S. Hwys. 13 & 158 | Highway | Swing | 60 ft. | 9.0 ft. |
| *50.2 | Camp Manu. Co. | Logging Railway | Swing | 49.5 ft. | 7.0 ft. |

* Use of this bridge discontinued in 1932. Rail and stringers removed. Draw chained in open position.

General Information Regarding Counties Within or Partially Within the Chowan River Basin

Bertie County - A large northern coastal county, Bertie is bounded on the east and south by the Roanoke River and on the east by the Chowan River. Its area within the Chowan River Basin comprises about one-third of the total area and lies in the northeastern portion of the county. It has fertile uplands, and lowlands with swamps along its borders on the two rivers.

Tobacco is the chief cash crop, followed by peanuts and corn. Hog raising is important. The soil is good for truck crops. Industrial operations are invariably small, with a large number of logging contractors and sawmills. The chief marine resources are fresh water fish.

The numerous navigable waterways of the county offer recreational possibilities, including swimming, fishing, and boating. The fishing for bass, bream, crappie, and pike in the rivers and numerous creeks is excellent.

Communities in the Chowan River Basin include Aulander, Powellsville, Colerain, Trap, Rosemead, Wakelon, Perrytown, Mount Gould, Ashland, Edenhouse, and Merry Hill.

| | |
|---|---|
| Rainfall (inches) | 44.86 |
| Snowfall (inches) | 6.7 |
| Mean annual temperature | 60.0 |
| Growing season (days) | 207 |
| Tobacco (1951 Val.) | $6,625,140 |
| Peanuts (1951 Val.) | $4,882,400 |
| Corn (1951 Va.) | $1,938,330 |
| Total Land Area (acres) | 443,520 |
| Forest Area (acres) | 302,900 |
| Total Tax Val. | $15,000,000 |
| Tax Rate | $1.00 |

Chowan County - This county, located in the northeast coastal area of the State, has considerable swamp land along the Chowan River, which forms the county's western boundary. Merchantable timber includes loblolly pine, tupelo, and black gum. Waters include the Chowan River, numerous creeks, the Yeopim River, which forms a separate basin between the Chowan River Basin and the Perquimans River Basin; and Albemarle Sound.

Edenton, county seat, is the largest peanut market in North Carolina and the second largest in the world. Other crops are cotton, corn, soybeans, tobacco, cantaloupes, and watermelons. The shad and herring fisheries have played an important part in Edenton's economy since its earliest days. The processing of these fish has been developed as an important local industry with canning and packing plants. In addition to these industries, Edenton has storage warehouses, peanut plants, lumber and veneer mills, fertilizer plants, and textile mills which make Edenton the cotton-yarn center of northeastern North Carolina. A Marine Corps Air Station is located at Edenton.

Recreational facilities in the county include boating, swimming, fishing, and hunting. Bass, perch, and bream are caught in Edenton Bay, Albemarle Sound, Chowan and Yeopim Rivers, Pembroke and Bethel Creeks and Dillard's and Bennett's Ponds.

Communities in the Chowan River Basin include Edenton, Center Hill, Rockyhock, Ryland, Icaria, Cisco, Gliden, Tyner, and Crossroads.

| | |
|---|---|
| Rainfall (inches) | 50.77 |
| Snowfall (inches) | 7.6 |
| Mean annual temperature | 60.6 |
| Growing season (days) | 217 |
| Peanuts (1951 Val.) | $1,664,830 |
| Corn (1951 Val.) | $875,790 |
| Tobacco (1951 Val.) | $546,750 |
| Total Land Area (acres) | 115,200 |
| Forest Area (acres) | 43,300 |
| Total Tax Val. | $11,333,518 |
| Tax Rate | $1.53 |

Gates County - In the northeast Coastal section, Gates is bordered on the west and south by the Chowan River and its tributaries, and on the north by Virginia. It is low, with broad areas of swamp along the Chowan River and along its eastern and southwestern borders. Principal merchantable species of trees are gum, loblolly, pine, and cypress. Waters include the Chowan River, numerous creeks, ponds, and swamps.

Mainly agricultural, the chief cash crop is peanuts. Other crops are corn, cotton, tobacco, hay, soybeans, watermelons, and Irish and sweet potatoes. Cattle, hogs, and poultry are important. Lumbering operations are generally small and are scattered throughout the county. In addition to logging camps and contractors, there are sawmills at Corapeake and Gatesville, and at other locations. Veneer logs, staves, and piling constitute the bulk of the output of these industries.

Recreational facilities include fishing, boating, and hunting. Bass, pike, and perch are caught in the Chowan River and in Catherine, Bennett, Beef, and other creeks. Bass, bream, and crappie are found in Williams Pond.

Communities in the Chowan River Basin include Gatesville (county seat), Sunbury, Gates, Eure, Roduco, Trotville, Hobbsville, Wardville, Savage, Wiggins, Crossroads, and Drum Hill.

| | |
|---|---|
| Rainfall (inches) | 48.50 |
| Mean annual temperature | 60.8 |
| Growing season (days) | 214 |
| Peanuts (1951 Val.) | $2,037,360 |
| Corn (1951 Val.) | $1,400,080 |
| Livestock (1950 Val.) | $770,000 |
| Total Land Area (acres) | 219,520 |
| Forest Area (acres) | 169,100 |
| Total Tax Val. | $8,250,000 |
| Tax Rate | $1.25 |

Hertford County - In the northern Coastal Region, Hertford is bounded on the east by the Chowan River and on the north by Virginia. Principal merchantable species of trees are loblolly pine, gum and oak. The waters include the Chowan, Meherrin and Wiccacon Rivers, and numerous creeks and swamps.

The chief crops are peanuts, tobacco, and cotton. Other crops include hay, corn, and some truck crops. The raising of hogs is important. Chief industries are lumbering and manufacture of wooden containers. In addition, a peanut-cleaning and peanut food-processing and storage plant, and tobacco-auction warehouses, are located at Ahoskie (market and retail center). Cotton gins are operated at Ahoskie and Murfreesboro. Small-scale commercial-fishing operations are carried on at Winton (county seat) and Tunis. A cooperative milk plant and a cucumber-pickle plant are located at Ahoskie. The milk plant receives milk from dairies in Hertford, Bertie, and Northampton Counties. Chowan College at Murfreesboro, which is the oldest Baptist Woman's School in the State and was closed during World Warr II, has been reopened. Tuscarora Beach near Winton has bathing, boating and dancing facilities. There is a similar beach for Negroes near Winton called Chowan Beach. Bass, perch, and crappie are caught in Wiccacon River and Potecasi Creek. Bass and perch are found in the Chowan and Meherrin Rivers and their tributaries.

Communities, in addition to those indicated above, include Union, Menola, Cofield, Tunis, Harrelsville, Mapleton, and Como.

| | |
|---|---|
| Rainfall (inches) | 49.24 |
| Snowfall (inches) | 7.9 |
| Mean annual temperature | 59.5 |
| Growing season (days) | 196 |
| Peanuts (1952 Val.) est. | $2,575,250 |
| Tobacco (1952 Val.) est. | $2,998,000 |
| Corn (1952 Val.) est. | $955,530 |
| Total Land Area (acres) | 227,840 |
| Forest Area (acres) | 139,000 |
| Total Tax Val. | $18,500,000 |
| Tax Rate | $1.38 |

Northampton County - In the northeast coastal region, Northampton County has a rolling topography, with some swamp land. There are extensive gravel deposits in the northwestern part of the county, and production of gravel occurs at Garysburg. Principal merchantable species of trees are loblolly pine, gum, poplar, oak, and cypress. Waters in the Chowan River Basin include the Meherrin River; Beaverpond, Cypress, Kirby's, Ramsey, Potecasi, and Cutawhiskie Creeks; and Jacks, Rogers, Corduroy, Wildcat, and Urahaw Swamps.

Northampton is the largest peanut-growing county in the State. Cotton and corn are also important crops. A large hay crop, comprised of peanut vines is produced, and soybeans are widely grown. Other crops include Irish and sweet potatoes, wheat, oats, and lespedeza. Livestock raising is on the increase. Lumbering is the only large industry, and an increasing demand for pulp in the State has created a market for much of the lumber produced in the county. Wooden containers and morticians' goods are manufactured at Woodland. A shirt factory is located at Rich Square, and a chemical plant is operated on the Meherrin River at Severn.

Bass and bream are caught in Jordan's Pond, from which the National Champion smallmouth bass was taken in 1940. Striped bass and perch are found in the Roanoke and Meherrin Rivers.

Communities in the Chowan River Basin include Jackson (county seat), Rich Square, Seaboard, Woodland, Conway, Severn, Milwaukee, George, Lasker, Potecasi, and Pendleton.

| | |
|---|---|
| Rainfall (inches) | 49.24 |
| Snowfall (inches) | 7.9 |
| Mean annual temperature | 59.5 |
| Growing season (days) | 196 |
| Peanuts (1952 Val.) | $5,500,000 |
| Cotton (1952 Val.) | $5,000,000 |
| Hogs (1952 Val.) | $2,500,000 |
| Total Land Area (acres) | 345,600 |
| Forest Area (acres) | 162,600 |
| Total Tax Val. (1952) | $17,275,281 |
| Tax Rate | $1.40 |

Watershed Boundary - The boundary line of the Chowan River Watershed

in a clockwise direction, extends generally as follows:

Beginning at a point on the shore of Albemarle Sound in Bertie County about two miles northeast of the mouth of Cashote Creek;

Thence along the ridge between Cashote Creek and Blackwalnut Swamp, along the ridge between Wading Place Creek and an unnamed tributary of Salmon Creek, and along the ridge between Flat Swamp and Cricket Swamp to the intersection of two unnumbered highways about two miles south of Perrytown;

Thence northwest to the intersection of two unnumbered highways about two miles southwest of Rosemead;

Thence southwest about four miles to Askewville;

Thence northwest, generally parallel to Connaritsa Swamp, approximately 12 miles to Aulander;

Thence southwest about one mile on an unnumbered highway;

Thence northwest about 3.5 miles on an unnumbered highway to its intersection with the Bertie-Hertford County Line;

Thence southwest about three miles to a point in Northampton County about two miles north of Roxobel in Bertie County;

Thence southwest along the Seaboard Air Line Railroad to Rich Square;

Thence west generally along an unnumbered highway to Bryantown;

Thence along the ridge between Urahaw Swamp and Roanoke River to Boones Cross-Roads;

Thence north along an unnumbered highway to Jackson;

Thence along the ridge between Gumberry Swamp and Ramsey Creek to a point on the Seaboard Air Line Railroad about three miles southwest of the Town of Seaboard;

Thence along the ridges between Gumberry Swamp and Cypress Creek, Author's Creek and Jack Swamp, Lees Creek and Beaverpond Creek, and Deep Creek and Beaverpond Creek to a point on the North Carolina-Virginia State Line about 3.5 miles northwest of Gaston;

Thence along the North Carolina-Virginia State Line to a point on the boundary between Gates County and Virginia about four miles northeast of Hazelton in Gates County;

Thence southeast through Hall Pocosin to a point on N. C. Highway 32 about two miles southwest of Holly Grove;

Thence south along the western edge of Dismal Swamp, passing slightly east of Wardville, to Joppa, about one mile southwest of Sandycross;

Thence along an unnumbered highway, forming the boundary between Chowan and Perquimans Counties for most of the distance, to Tyner in Chowan County;

Thence south about 8.5 miles to a point on the Norfolk Southern Railroad about two miles northeast of Edenton;

Thence southeast about five miles to the intersection of N. C. Highways 32 and 37 near St. Johns; and

Thence along N. C. Highway 32 to the north end of N. C. Highway 32 bridge across Albemarle Sound.

Chowan River Basin Streams - There follows a list, alphabetically arranged, of streams in the Chowan River Basin in North Carolina, the names of which are shown on available maps. There are numerous streams on such maps, the names of which are not indicated. There are shown on the following list the stream into which each of the streams, alphabetically arranged, flows, and also the county in which the junction of the corresponding two streams is located. It is believed that this list will be helpful to interested persons in quickly locating on a county, topographical, or other map, any stream included in the list and also to trace the course of the stream throughout the basin.

| STREAM | RECEIVING STREAM | COUNTY IN WHICH JUNCTION OCCURS |
|---|---|---|
| Ahoskie Creek | Wiccacon River | Hertford |
| Banks Creek | Meherrin River | Hertford |
| Bear Swamp | Ahoskie Creek | Hertford |
| Beaverdam Swamp | Stony Creek | Bertie |
| Bells Branch | Potecasi Creek | Hertford |
| Bennetts Creek | Chowan River | Gates |
| Blackwalnut Swamp | Chowan River | Bertie |
| Blackwater River | Chowan River | Gates |
| Bluewater Branch | Cutawhiskie Swamp | Hertford |
| Branes Creek | Chowan River | Gates |
| Brooks Creek | Wiccacon River | Hertford |
| Buckland Mill Branch | Cole Creek | Gates |
| Chapel Branch | Cutawhiskie Swamp | Hertford |
| Chinkapin Creek | Wiccacon River | Hertford |
| Chinkapin Swamp | Chinkapin Creek | Hertford |
| Cole Creek | Saren Creek | Gates |
| Corduroy Swamp | Kirbys Creek | Northampton |
| Cricket Swamp | Eastmont Swamp | Bertie |
| Cutawhiskie Swamp | Potecasi Creek | Hertford |
| Deep Creek | Chowan River | Hertford |
| Deep Swamp Branch | Chowan River | Hertford |
| Dillard Creek | Chowan River | Chowan |
| Duke Swamp | Bennetts Creek | Gates |
| Eastmont Swamp | Salmon Creek | Bertie |
| Flat Branch | Cole Creek | Gates |
| Flat Swamp | Bear Swamp | Hertford |
| Fort Branch | Ahoskie Creek | Hertford |
| Hackland Branch | Flat Branch | Gates |
| Hares Branch | Meherrin River | Hertford |
| Harrell Swamp | Bennetts Creek | Gates |
| Horse Swamp | Bear Swamp | Hertford |
| Kill'em Swamp | Chinkapin Creek | Hertford |
| Kirbys Creek | Meherrin River | Northampton |
| Liverman Creek | Meherrin River | Hertford |

| STREAM | RECEIVING STREAM | COUNTY IN WHICH JUNCTION OCCURS |
|---|---|---|
| Long Branch | Kill'em Swamp | Hertford |
| Maple Fork Branch | Kirbys Creek | Northampton |
| Meherrin River | Chowan River | Hertford |
| Middle Swamp | Duke Swamp | Gates |
| Mill Branch | Potecasi Creek | Hertford |
| Mud Creek | Chowan River | Gates |
| Nottoway River | Chowan River | Gates |
| Pembroke Creek | Chowan River | Chowan |
| Pollock Swamp | Pembroke Creek | Chowan |
| Potecasi Creek | Meherrin River | Hertford |
| Quarter Swamp | Urahaw Swamp | Northampton |
| Queen Anne Creek | Chowan River | Chowan |
| Quioccosin Swamp | Stony Creek | Bertie |
| Ramsey Creek | Potecasi Creek | Northampton |
| Rockyhock Creek | Chowan River | Chowan |
| Rogers Swamp | Kirbys Creek | Northampton |
| Salmon Creek | Chowan River | Bertie |
| Saren Creek | Chowan River | Gates |
| Stony Creek | Ahoskie Creek | Hertford |
| Trotman Creek | Chowan River | Gates |
| Turkey Creek | Ahoskie Creek | Hertford |
| Urahaw Swamp | Potecasi Creek | Northampton |
| Warwick Creek | Trotman Creek | Gates |
| Whiteoak Swamp | Ahoskie Creek | Hertford |
| Wiccacon River | Chowan River | Hertford |
| Wildcat Swamp | Stony Creek | Bertie |
| Wilcat Swamp | Potecasi Creek | Northampton |

## CHAPTER II _ USE OF WATER FOR DOMESTIC AND MUNICIPAL PURPOSES

Water Uses - Water uses in the Chowan River Basin include industrial water supplies; bathing, boating, and other forms of recreation; fish and wildlife propagation; agriculture, including livestock watering and irrigation; and waste disposal. All domestic water supplies in the Basin are obtained from wells.

Public Water Supplies - There are nine public water supplies within the Basin. These supplies serve approximately 14,500 people who use about one million gallons per day. The 1950 population of these nine communities was 14,593. All of them use ground water. There are no towns using surface water supplies.

N. C. - Virginia State Line to Mouth of Meherrin River - All towns and communities in this area obtain their domestic water supplies from wells.

Mouth of Meherrin River to A.C.L. Railroad Bridge Across Chowan River near Tunis - The Town of Winton, which is the only community in this area, obtains its water supply from wells.

A.C.L. Railroad Bridge across Chowan River near Tunis to Mouth of Chowan River, excluding Beaches - All towns and communities in this area obtain their domestic water supplies from wells.

Mouth of Chowan River, including Edenton Bay and Adjacent Waters, to a Line extending from the Mouth of Blackwalnut Swamp, Bertie County, to North End of Norfolk-Southern Railroad Bridge across Albemarle Sound - The Town of Edenton is the only town located in this area and receives its domestic water supplies from deep wells.

Descriptions and Chemical Character of Public Water Supplies - "Progress Report No. 2, Public Ground-Water Supplies in North Carolina, U. S. Geological Survey, Raleigh, 1949", prepared in cooperation with the North Carolina State Board of Health, contains the following information regarding public water supplies in the Chowan River Basin, additional to that indicated in Chapter VII herein and obtained from a survey by State Stream Sanitation Committee personnel in 1955.

Ahoskie, Hertford County, Altitude 59

| | Well I | Well 2 |
|---|---|---|
| Ownership | Municipal | Municipal |
| Depth (ft) | 264 | 300 |
| Diameter (in.) | 6 | 6 |
| Yield (g.p.m.) | 300 | 200 |
| Date of observation | May 25, 1948 | May 25, 1948 |
| Color | 3 | 4 |
| pH | 7.2 | 7.2 |
| Silica | 33 | 32 |
| Iron | .23 | .22 |
| Manganese | 0 | 0 |
| Calcium | 7.7 | 8.7 |
| Magnesium | 5.9 | 6.7 |

Ahoskie, Hertford County, Altitude 59 (Cont.)

| | Well I | Well 2 |
|---|---|---|
| Sodium & potassium | 79 | 86 |
| Bicarbonate | 247 | 268 |
| Sulfate | 3.5 | 5.2 |
| Chloride | 5.2 | 6.2 |
| Fluoride | 0.4 | 0.5 |
| Nitrate | 1.0 | 1.2 |
| Dissolved solids | 261 | 283 |
| Total hardness | 43 | 49 |

Aulander, Bertie County, Altitude 73

| | Well |
|---|---|
| Ownership | Municipal |
| Depth (ft.) | 354 |
| Diameter (in.) | 8 |
| Yield (g.p.m.) | 400 |
| Date of observation | March 18, 1947 |
| Color | 3 |
| pH | 7.3 |
| Silica | 53 |
| Iron | .13 |
| Manganese | 0 |
| Calcium | 52 |
| Magnesium | 3.0 |
| Sodium & potassium | 28 |
| Bicarbonate | 231 |
| Sulfate | 1.7 |
| Chloride | 8.2 |
| Fluoride | 0.2 |
| Nitrate | 0.4 |
| Dissolved solids | 264 |
| Total hardness | 142 |

Colerain, Bertie County

| | Well |
|---|---|
| Ownership | Municipal |
| Depth (ft.) | 250 |
| Diameter (in.) | 6 |
| Yield (g.p.m.) | 75 |
| Date of observation | July 3, 1947 |
| Color | 4 |
| pH | 7.4 |
| Silica | 51 |
| Iron | .26 |
| Manganese | 0 |
| Calcium | 24 |
| Magnesium | 13 |
| Sodium & potassium | 27 |
| Bicarbonate | 198 |

Colerain, Bertie County (Cont.)

| | Well |
|---|---|
| Sulfate | 3.3 |
| Chloride | 3.2 |
| Fluoride | .7 |
| Nitrate | 0 |
| Dissolved solids | 224 |
| Total hardness | 113 |

Edenton, Chowan County, Altitude 16

| | Va. Rd. Well | Freeman Well |
|---|---|---|
| Ownership | Municipal | Municipal |
| Depth (ft.) | 358 | 290 |
| Diameter (in.) | 8 | 12 |
| Yield (g.p.m.) | 500 | 700 |
| Date of observation | May 24, 1947 | May 24, 1947 |
| Color | 17 | 13 |
| pH | 7.4 | 7.4 |
| Silica | 50 | 52 |
| Iron | .33 | .18 |
| Manganese | 0 | 0 |
| Calcium | 58 | 58 |
| Magnesium | 13 | 14 |
| Sodium & potassium | 174 | 156 |
| Bicarbonate | 477 | 463 |
| Sulfate | 32 | 31 |
| Chloride | 106 | 90 |
| Fluoride | 1.0 | 1.3 |
| Nitrate | 0.2 | 0.2 |
| Dissolved solids | 690 | 656 |
| Total hardness | 198 | 202 |

Murfreesboro, Hertford County

| | Well I | Well 2 |
|---|---|---|
| Ownership | Municipal | Municipal |
| Depth (ft.) | 228 | 320 |
| Diameter (in.) | 3 | 8 |
| Yield (g.p.m.) | 80 | 300 |
| Date of observation | May 1, 1948 | May 1, 1948 |
| Color | 7 | 3 |
| pH | 8.0 | 7.7 |
| Silica | 23 | 30 |
| Iron | .28 | .42 |
| Manganese | 0 | 0 |
| Calcium | 0.4 | 1.8 |
| Magnesium | 0.4 | 0.8 |
| Sodium & potassium | 68 | 70 |
| Bicarbonate | 166 | 183 |
| Sulfate | 4.4 | 4.1 |
| Chloride | 6.8 | 4.0 |

Murfreesboro, Hertford County (Cont.)

| | Well I | Well 2 |
|---|---|---|
| Fluoride | 0.3 | 0.3 |
| Nitrate | 0.4 | 0.4 |
| Dissolved solids | 187 | 201 |
| Total hardness | 3 | 8 |

Seaboard, Northampton County, Altitude 126

| | Well |
|---|---|
| Ownership | Municipal |
| Depth (ft.) | 390 |
| Diameter (in.) | 12 |
| Yield (g.p.m.) | 280 |

| | Sample of raw water | Sample of treated water |
|---|---|---|
| Date of observation | June 30, 1949 | June 30, 1949 |
| Color | 2 | 5 |
| pH | 6.0 | 9.2 |
| Silica | 41 | 35 |
| Iron | 3.4 | 0.62 |
| Manganese | 0 | 0 |
| Calcium | 3.8 | 22 |
| Magnesium | 1.3 | 1.1 |
| Sodium & potassium | 6.2 | 6.7 |
| Bicarbonate | 22 | 45 |
| Sulfate | 6.7 | 31 |
| Chloride | 2.1 | 5.9 |
| Fluoride | 0.1 | 0.1 |
| Nitrate | 0.1 | 0.2 |
| Dissolved solids | 80 | 127 |
| Total hardness | 15 | 39 |

Winton, Hertford County, Altitude 45

| | Well I | Well 2 |
|---|---|---|
| Ownership | Municipal | Municipal |
| Depth (ft.) | 180 | 314 |
| Diameter (in.) | 6 | 8 |
| Yield (g.p.m.) | 50 | 450 |
| Date of observation | December 28, 1948 | December 28, 1948 |
| Color | 6 | 4 |
| pH | 8.1 | 8.2 |
| Silica | 13 | 12 |
| Iron | 5.6 | 0.34 |
| Manganese | 0 | 0 |
| Calcium | 3.1 | 0.8 |
| Magnesium | 0.9 | 0.9 |
| Sodium & potassium | 143 | 145 |
| Bicarbonate | 290 | 287 |
| Sulfate | 13 | 13 |
| Chloride | 48 | 48 |

Winton, Hertford County, Altitude 45 (Cont.)

| | Well I | Well 2 |
|---|---|---|
| Fluoride | 1.3 | 1.3 |
| Nitrate | 0.5 | 0.7 |
| Dissolved solids | 370 | 369 |
| Total hardness | 11 | 6 |

## CHAPTER III - USE OF WATER FOR AGRICULTURE

### Agricultural Use in Various Sections of the Basin

N. C. - Virginia State Line to Mouth of Meherrin River - In general, the area is level and gently rolling, with the rolling areas being interspersed with many swamps. Most streams are just a few feet above sea level. Practically all of the streams have relatively wide overflow bottoms. Drainage is mainly poor in the level to gently undulating areas, and good in the more rolling areas. A large portion of the area is covered with trees.

Considerable farming is done in this area. One of the largest peanut-growing areas in the State is located here. Other important crops are corn, cotton, and tobacco.

Mouth of Meherrin River to A.C.L. Railroad Bridge across Chowan River near Tunis, Hertford County - This area of the Chowan River Basin is divided into two distinct regions. The region in Gates County adjacent to the main stream is composed entirely of swampland at sea-level elevation, while the region in Hertford County has elevations ranging from sea level to 40 feet. Drainage is poor in the low, swampy areas and good in areas of higher elevations. In most cases, the low areas are affected by wind tides on the Chowan River.

Some farming is being done in the area west of the main stem. The cash crops are peanuts, cotton, and tobacco.

A.C.L. Railroad Bridge near Tunis to Mouth of Chowan River, excluding Beaches - This area of the Chowan River Basin contains the longest segment of the main stem. The Chowan River has a total length of approximately 52 miles in North Carolina, of which approximately 35 miles lie within this area. Four of the five counties in the Basin are adjacent to the main stem in this area, and segments of all of these counties are included therein.

As reported for the section immediately upstream, this section also has two distinct regions. The lands bordering the main stem in Gates and Hertford Counties, located in the northern part of this section, are almost entirely in swampland. In most cases, the area is affected by wind tides on the main stem. The areas located in the southwestern part of Hertford County and the southeastern part of Gates County are level and gently rolling, with the rolling areas being interspersed with many swamps. Drainage is good for the rolling areas and poor for the swampy areas.

The area located in the southern part of this section, which includes segments of Bertie and Chowan Counties, has excellent drainage. The area in Bertie County along the Chowan River has an almost continuous, abrupt bluff, 20 to 40 feet in height. The area in Chowan County is level, with scattered swampland.

Agriculture is diversified in this area. The main cash crops are tobacco, peanuts, corn, and cotton. Commercial truck farming is widespread and increasing each year. The growing of livestock, especially beef cattle, is also increasing.

Livestock watering comprises the principal agricultural usage of the streams in this portion of the Basin. Irrigation is, however, practiced in some sections, and this water usage is increasing.

Mouth of Chowan River, including Edenton Bay and Adjacent Waters to a Line extending from Mouth of Blackwalnut Swamp, Bertie County, to North End of Norfolk-Southern Railroad Bridge across Albemarle Sound - The topography of this area, which includes a small segment of Bertie County and most of the lower portion of Chowan County, is level, with elevations a few feet above sea level. The area is more heavily populated than the above three areas of the Basin within North Carolina, mainly because the Town of Edenton is located therein.

The soil in this area is fertile and suitable for agricultural purposes. Some of the more important cash crops are peanuts, corn, tobacco and cotton.

The agricultural use of the streams is principally that of livestock watering. The use of stream water for irrigation purposes, however, is increasing rapidly.

Data regarding Agricultural Production - Information regarding farm population, total land in farms, harvested cropland, idle cropland, and use of fertilizer, according to the 1952 Farm Census of 1951 Crops, for the five counties within or partially within the Chowan River Basin, is shown below. Approximate figures for the portions of these counties that lie within the Basin may be obtained by using the following percentages: Bertie-28, Chowan-61, Gates-77, Hertford-100, and Northampton-66. The figures shown in the table below are in acres, unless otherwise indicated.

| ITEM | Bertie County | Chowan County | Gates County | Hertford County | Northampton County | Total for the five counties |
|---|---|---|---|---|---|---|
| Harvested Cropland | 85,512 | 33,699 | 39,377 | 56,104 | 111,253 | 325,945 |
| Idle Cropland | 3,754 | 1,665 | 1,212 | 2,435 | 6,269 | 15,335 |
| Pasture | 6,130 | 2,662 | 3,503 | 4,236 | 9,871 | 26,402 |
| Woods, Home-Sites,etc. | 193,006 | 48,689 | 80,395 | 111,674 | 176,042 | 609,006 |
| Corn Harvested | 32,400 | 13,434 | 21,623 | 19,831 | 31,531 | 118,819 |
| Cotton Harvested | 9,455 | 3,090 | 3,233 | 6,159 | 27,626 | 49,563 |
| Tobacco Harvested | 8,743 | 870 | 416 | 5,100 | 661 | 15,790 |
| Peanuts | 29,830 | 7,955 | 9,676 | 20,386 | 39,616 | 107,463 |
| Wheat | 13 | 48 | 46 | 76 | 552 | 735 |
| Oats | 249 | 14 | 40 | 131 | 1,045 | 1,477 |
| Other Small Grains | 23 | 28 | 36 | 103 | 434 | 644 |
| Soybeans | 5,666 | 5,492 | 2,759 | 3,764 | 6,688 | 24,369 |
| Lespedeza | 13 | - | 25 | 59 | 247 | 344 |
| Hay Crops Harvested | 643 | 391 | 153 | 488 | 2,378 | 4,053 |
| Other Hays Cut | 83 | 23 | 3 | 52 | 739 | 900 |
| Irish Potatoes | 278 | 58 | 33 | 226 | 399 | 994 |
| Sweet Potatoes | 549 | 228 | 221 | 311 | 504 | 1,813 |
| Other Vegetables Grown | 585 | 2,515 | 127 | 212 | 361 | 3,800 |
| Other Crops Harvested | 635 | 363 | 217 | 428 | 1,385 | 3,028 |
| Total Land in Farms | 288,402 | 86,715 | 124,487 | 174,449 | 303,435 | 977,488 |
| Total Land Area | 443,520 | 115,200 | 219,520 | 227,840 | 345,600 | 1,351,680 |
| Comm. Fert. Used, Tons | 18,704 | 7,778 | 8,623 | 13,073 | 19,539 | 67,717 |

| ITEM | Bertie County | Chowan County | Gates County | Hertford County | Northampton County | Total for the five counties |
|---|---|---|---|---|---|---|
| Sows and Gilts, No. | 5,311 | 1,976 | 2,664 | 2,906 | 4,972 | 17,829 |
| Cows and Heifers, No. | 2,606 | 744 | 1,507 | 1,228 | 3,172 | 9,257 |
| Hens and Pullets, No. | 70,801 | 33,334 | 37,406 | 45,473 | 100,251 | 287,265 |
| Tractors in Usable Condition, No. | 1,276 | 513 | 622 | 737 | 1,112 | 4,260 |
| Farm, Population, No. | 16,075 | 5,426 | 5,846 | 9,976 | 18,110 | 55,433 |
| Total Population 1950, No. | 26,439 | 12,540 | 9,555 | 21,453 | 28,432 | 98,419 |

## CHAPTER IV--USE OF WATER FOR INDUSTRIAL PURPOSES

Commercial Fishing-- Shad and herring fisheries have played an important part in the economy of the Chowan River Basin. The processing of these fish has developed into an important industry with numerous fish-canning and fish-packing plants located in the area. The alewife (herring) are the most abundant food fish inhabiting the rivers of the North Carolina Coast, and they make up one-third of the total weight of all fish taken commercially in the State. In addition, white catfish are of considerable commercial importance and constitute an important food for many of the less prosperous families of the Coastal Plain area.

The following tabulation shows the volume of water products shipped from four points on the Chowan River during the calendar year ending December 31, 1953.

| Location | Fish (Pounds) |
|---|---|
| Cannons Ferry | 1,810,000 |
| Colerain | 5,800,000 |
| Edenton | 1,926,000 |
| Harris Landing (Tynches) | 1,730,000 |
| Total | 11,266,000 |

N. C.-Virginia State Line to Mouth of Meherrin River-- The principal industry outside of agriculture is lumbering. Many small mills operate throughout the area. Main wood products are pilings, veneer, shingles, and flooring. One industry, Riverside Manufacturing Company, located at Murfreesboro, obtains water from the Meherrin River for industrial use. Commercial fishing is confined mainly to the main stem of the Chowan River, and to the annual herring run in the Spring of the year.

Mouth of Meherrin River to A. C. L. Railroad Bridge across Chowan River near Tunis, Hertford County-- There is little industry other than lumbering.

A. C. L. Railroad Bridge across Chowan River near Tunis to Mouth of Chowan River, excluding Beaches--Industry is invariably small, with a large number of logging contractors and sawmills throughout the area. Almost all of the commercial fisheries in the Basin are concentrated in this area. Industry, other than lumbering and fishing, is located in and around the Town of Ahoskie, a wholesale and retail center in the south-central part of Hertford County. Some industries, such as the commercial fish industry, obtain their industrial water from Chowan River.

There are six main commercial fisheries located in this section of the Basin. All of the fisheries are located on the main stem. The names and locations of these fisheries are as follows:

Cannon Ferry Fish Co., Cannon Ferry, Chowan County
Chowan Fish Co., Cannon Ferry, Chowan County
M. J. Tynch and Company, Harris Landing, Chowan County
Belch Fish Co., Colerain, Bertie County
Perry-Winn Fish Co., Colerain, Bertie County
J. W. Waff and Sons, Edenhouse, Bertie County

Generally, all fish houses are operated in the same manner. The operations of the various fish houses are confined mainly to the herring season, which normally begins about the first of April and lasts until the middle of May. Herring is the main fish product, followed by rockfish, perch, shad, carp, and catfish. Plant operations consist of washing and cleaning, packing, and canning of fish roe. Most of the offal (fish solids) are collected and rendered into fish meal. Chowan River water is used for cleaning of fish, and well water is used for cleaning of fish roe. Wastes, consisting of blood, wash water, and some fish solids, are discharged to Chowan River without treatment, which constitutes a local pollution problem in the vicinity of the plant. These organic wastes have a high demand for oxygen and cause surface films and other undesirable conditions.

Mouth of Chowan River, including Edenton Bay and Adjacent Waters, to a Line extending from the Mouth of Blackwalnut Swamp, Bertie County to North End of Norfolk-Southern Railroad Bridge across Albemarle Sound--Industries are variable and are concentrated in and around the Town of Edenton. The largest peanut market in North Carolina is reported to be at Edenton. Other industries located in this area include shad and herring fisheries with their packing and canning plants, a textile mill that manufactures cotton yarn, fertilizer plants, and lumber and veneer plants. Commercial fishing is mainly confined to the main stem of Chowan River and Albemarle Sound.

One industry, Edenton Cotton Mills, Inc., located at Edenton, obtains water from Queen Anns Creek for industrial use. In addition, most of the commercial-fish industries obtain water for industrial use from Edenton Bay.

## CHAPTER V--USE OF WATER FOR RECREATION

Recreation in General--The main recreational activities are boating, swimming, fishing, and hunting. There are no National or State parks in the Basin within North Carolina. There is, however, one State historical park, the James Iredell House located at Edenton. The flat, swampy nature of the area provides little incentive to hiking, camping, etc., except for that done in connection with hunting and fishing. Large and small mouth bass, perch, crappie, pike, and bream are found in the North Carolina waters in the Basin. Quail, water fowl, wild turkey, deer, and even some bears make hunting in this area a favorite sport.

According to information furnished by the North Carolina Wildlife Resources Commission, the value of hunting and fishing in the five counties, lying wholly or partially within the Basin has been estimated at $724,645 for hunting and $521,650 for fishing. These estimates include the cost of hunting and fishing licenses as well as expenditures made by persons while engaged in these activities.

N. C.-Virginia State Line to Mouth of Meherrin River-- For sport fishing, large and small mouth bass, pike, perch, bream, and crappie are found in most of the streams. Because of the coverage provided by the woodland, this area is a natural habitat for wildlife. As would be expected, hunting and camping activities are extensive. Deer and bear hunting is good. Some quail, waterfowl, and wild turkey are found along the banks of the Chowan River.

Mouth of Meherrin to A. C. L. Railroad Bridge across Chowan River near Tunis-- The most important use of the waters in this area is recreational. Fishing, especially sport fishing is widespread throughout the area. Fish normally caught in these waters are the large mouth bass, perch, and herring in the spring of the year.

Two organized bathing areas, Tuscarora and Chowan Beaches, are located in this area. Tuscarora Beach is located on the west bank of the Chowan River downstream from Winton. Recreation facilities include bathing, boating, and dancing. Studies by State Stream Sanitation Committee personnel indicate that this beach is being polluted by wastes from Winton.

Chowan Beach is operated for Negroes, with recreational facilities for bathing, boating, and dancing, and is located on the west bank of Chowan River approximately 1.4 miles below the confluence of Meherrin River with the main stem. Studies by State Stream Sanitation Committee personnel indicate that this beach is not being polluted. It may, however, be affected at times by waste in the Chowan River from Virginia and by waste in the Meherrin River from the Town of Murfreesboro.

A. C. L. Railroad Bridge across Chowan River near Tunis to Mouth of Chowan River, excluding Beaches-- The use of the streams for bathing and boating is prevalent throughout this part of the Chowan River Basin. At present the only bathing area being operated for the public is at Colerain Beach. Studies by State Stream Sanitation Committee personnel indicate that this beach is being polluted by sewage from the Town of Colerain. The area in the vicinity of Edenhouse, at the western end of the U. S. Highway 17

Bridge across the Chowan River, is widely used for bathing. It has, however, no bathhouse facilities available for the bathers. In addition, there is swimming near Mount Gould, a community in Bertie County approximately half-way between Colerain and Edenhouse. A summer camp, sponsored by Kiwanis clubs for underprivileged boys, is located near Mount Gould.

Fishing is general throughout the streams of this area, particularly in the main stem. The chief species of fish commonly caught are reported to be bass, perch, bream, jack, and pike. Hunting is carried on in most of the area, and is good for quail and fair for wild turkey, deer, and bear.

Mouth of Chowan River, including Edenton Bay and Adjacent Waters to a Line extending from the Mouth of Blackwalnut Swamp, Bertie County, to North End of Norfolk-Southern Railroad Bridge across Albemarle Sound--There is no organized bathing in this section of the Basin. Boating and sport fishing are prevalent in all waters in this area. Fish commonly caught are bass, perch, bream, and jack.

Stream Flow--Of the 15 active gaging stations in the Chowan River Basin, only one is located in North Carolina. This station has been established on Ahoskie Creek at the Town of Ahoskie in the southern part of Hertford County, and is maintained and operated under a cooperative agreement between the United States Geological Survey and the North Carolina Department of Conservation and Development.

The locations of four of the 15 gaging stations, at which water-stage recordings are made, drainage areas thereof, duration of available records, and the maximum average, minimum, minimum daily, and minimum consecutive 7-day discharges thereat are set forth below.

Nottoway River, 2.5 miles southwest of Sebrell, Southampton County, Virginia

Drainage area--1,451 square miles
Records available--Sept. 1941 to Sept. 1953
Maximum, August 1940 flood, 48000 cfs
Average (12 years)--1,230 cfs
Minimum, Oct. 23, 1941--12 cfs
Minimum daily, Oct. 23, 1941--16 cfs
Minimum consecutive 7-day, Oct. 17-23, 1941-21.1 cfs

Blackwater River, 6 miles north of Franklin, Southampton County, Virginia

Drainage area--613 square miles
Records available--Aug. 1944 to Sept. 1953
Maximum, July 25, 1945--5,360 cfs
Average (9 years)--591 cfs
Minimum, Sept. 10, 11, 1944--0.4 cfs
Minimum daily, Sept. 10, 1944--0.4 cfs
Minimum consecutive 7-day, Aug. 26, Sept. 1, 1944

(Diversion above Station by City of Norfolk for municipal supply some years)

Meherrin River, 3 miles southeast of Lawrenceville, Brunswick County, Virginia

Drainage area--553 square miles
Records available--Dec. 1928 to Sept. 1953
Maximum, Aug. 17, 1940--38,000 cfs
Average (24 years)--505 cfs
Minimum Sept. 23, 24, 1932--5 cfs
Minimum daily, Sept. 24, 1932--5 cfs
Minimum consecutive 7-day Sept. 19-25, 1932--6.6 cfs

Ahoskie Creek, 0.75 mile southwest of Ahoskie, Hertford County, North Carolina

Drainage area--64.3 square miles.
Records available--Jan. 1950 to Sept. 1953
Maximu, Feb. 29, 1952--904 cfs
No flow at times.

Flow data for the gaging stations in Virginia is available through the District Engineer, United States Geological Survey, Charlottesville, Virginia. Flow data for Ahoskie Creek are available through

the District Engineer, United States Geological Survey, Raleigh, North Carolina.

Measurements of Stream Flow at Various Points-- The following streamflow measurements are taken from annual publications of Bulletin 52, North Carolina Department of Conservation and Development, "Chemical Character of Surface Waters of North Carolina", prepared in cooperation with the Geological Survey of the United States, Department of the Interior.

| Source | Date | Mean discharge (second ft.) |
|---|---|---|
| Potecasi Creek at Potecasi | Aug. 11, 1949 | 20.9 |
| Ahoskie Creek at Ahoskie | Aug. 11, 1949 | 184.0 |
| Bennetts Creek near Gatesville | Aug. 12, 1949 | 25.2 |
| Meherrin River near Severn | Oct. 19, 1949 | 222.0 |
| Meherrin River near Severn | Jan. 17, 1950 | 678.0 |
| Meherrin River nr. Severn | Mar. 8, 1950 | 515.0 |
| Meherrin River near Severn | Apr. 18, 1950 | 404.0 |
| Meherrin River near Severn | Aug. 26, 1950 | 856.0 |
| Potecasi Creek at Potecasi | Apr. 18, 1950 | 13.4 |
| Potecasi Creek at Potecasi | Sept. 4, 1950 | 8.7 |
| Ahoskie Creek at Ahoskie | Dec. 13, 1949 | 32.9 |
| Ahoskie Creek at Ahoskie | Mar. 8, 1950 | 26.3 |
| Ahoskie Creek at Ahoskie | Apr. 19, 1950 | 6.7 |
| Ahoskie Creek at Ahoskie | Aug. 26, 1950 | 13.0 |
| Bennetts Creek near Gatesville | Dec. 13, 1949 | 29.8 |
| Bennetts Creek near Gatesville | Apr. 19, 1950 | 10.1 |
| Bennetts Creek near Gatesville | Sept. 3, 1950 | 3.67 |
| Bennetts Creek near Gatesville | June 5, 1951 | 3.86 |
| Duke Swamp near Sunbury | Sept. 11, 1952 | 0.05 |

## CHAPTER VII--GROUND WATER

Geology of the Coastal Plain--The formations of the Coastal Plain, in which that part of the Chowan River Basin within North Carolina lies, are very different from those of the Piedmont and Mountain sections of the State. In contrast with the hard, crystalline rocks of those areas, the formations of the Coastal Plain consist of unconsolidated and semi-consolidated sediments deposited in, and along the margin of, a sea that once covered the eastern part of the State.

Geological History of the Coastal Plain-- At the beginning of Cretaceous time, the land had been worn down to a plain of low relief. The rocks were deeply decayed, and a thick layer of weathered material covered the surface. At this time, the land began to be tilted gently to the southeast, so that eastern North Carolina was covered by a shallow sea which extended far up the broad valleys that had been developed in the crystalline rocks. The weathered and decayed material to the west was carried southeastward and deposited in the stream channels and adjacent flood plains, in the bays and estuaries, and along the sea margin, resulting in the basal sand and clay strata of the Cretaceous age. As these broad valleys were filled, subsidence continued so that, in later cretaceous time, the land waste was carried into the sea, forming the marine deposits now known as the Black Creek and Peedee formations. At the end of the Cretaceous time, the land was elevated relative to sea level, so that a long period of erosion removed much of the material previously deposited.

In lower Eocene time, the sea again encroached on the land. Only a few remnants of the sediments deposited in it, however, have been found, and these remnants are at relatively high levels along the western edge of the Coastal Plain. However, evidence of the presence of sand and clay strata of lower Eocene age, beneath the Yorktown formation in northeastern North Carolina which occurred in the Miocene age, was discovered about ten years ago. In later Eocene time, the limestones and calcareous sands and sandstones of the Castle Hayne marl (occurring along the North Carolina coast between the lower part of the Neuse River and the North Carolina-South Carolina State Line) were deposited uncomformably overlying the uppermost Cretaceous deposits.

It appears that the Coastal Plain remained above sea level in Oligocene time. In lower Miocene time, however, the sea again transgressed on the land, and the Trent marl was deposited uncomformably over the Castle Hayne marl. In later Miocene time, a more extensive submergence occurred, and the sea extended completely across the present Coastal Plain in the northern part of the State and most of the way across in the southern part. The formations of the later Miocene time include the Yorktown in the north and the Duplin marl in the south.

In Pleistocene time, the sea rose to as much as 270 feet above its present level. It withdrew and advanced a number of times thereafter, and, at each successively lower stand, formed a terrace, just as a terrace is being formed at the present time along the coast.

Ground Water of the Coastal Plain--In contrast with the Piedmont Plateau, most parts of the Coastal Plain will yield, large quantities of water to wells. Supplies of several million gallons a day can be obtained at many

places, and adequate supplies for most industrial uses can be obtained at almost any place in the Coastal Plain except along its western margin. A number of wells have been drilled that yielded 1000 or more gallons a minute, and many others which were tested at 300 or 400 gallons a minute, with a drawdown of only a few feet, undoubtedly would yield several times their tested capacity.

Because the amount of ground water withdrawn from the Coastal Plain has been small compared to the amount available, little attention has been given to the total perennial yield. Very few data are available regarding the permeability of the formations, amount of recharge, or fluctuations of the water level.

The total potential ground-water supply in the North Carolina Coastal Plain is determined principally by the amount of recharge, and is probably several thousand million gallons a day. At many places, several million gallons a day can safely be removed from a small area, provided pumpage in adjacent areas is light. Probably not more than 500,000 gallons a day could safely be withdrawn per square mile, if each square mile were being pumped over a large area.

Ground Water of the Coastal Plain Unit Areas - The State of North Carolina is divided into nine hydrologic unit-areas, of which Unit-Area Nos. 1, 2, 3, and 4 include the Coastal Plain. Nos. 1 and 3 are separated by the Neuse River and its tributary, Contentnea Creek, and include the northeastern part of North Carolina, and Nos. 2 and 4 include the southeastern part of North Carolina. The western boundary of Area 3 runs generally along the main line of the Atlantic Coast Line Railroad.

In the Chowan River Basin, Bertie, Hertford, and Northampton Counties, and the western part of Gates County, are in Unit-Area No. 3. Chowan County and the eastern part of Gates County lie in Unit-Area No. 1. A summary of the ground-water conditions in Unit-Areas Nos. 1 and 3 follows.

Hydrologic Unit-Area No. 1 - On a line between Colerain and Elizabeth City, the Yorktown Formation, consisting of marls, clays, and sands extends to about 200 feet below the surface at Colerain and to about 500 feet below the surface at Elizabeth City. On a line between Windsor and Edenton, the Yorktown Formation extends to about 200 feet below the surface at Windsor and about 400 feet below the surface at Edenton. Below the Yorktown Formation are Eocene and Cretaceous strata, which cannot generally be used as a source of supply because the salt content of the water is too high.

The Pleistocene deposits above the Yorktown Formation furnish good supplies in some places, at which some wells less than 100 feet deep yeild 250 gallons a minute. The Yorktown Formation will furnish large amounts of water, and yields of 1000 gallons a minute probably can be obtained at many places. In some places, the water from this formation cannot be used because it is brackish.

The water in Unit-Area 1 is usually moderately hard to very hard, and the iron content, especially in the shallower beds, is apt to be high.

Hydrologic Unit-Area No. 3 - The Yorktown Formation extends to about 50 feet at Jackson, 75 feet at Woodland, and 150 feet at Winton and Ahoskie.

The Pleistocene terraces above the Yorktown Formation are usually 20 to 30 feet thick. The Yorktown Formation averages 40 to 50 feet thick in Northampton County, becoming increasingly thicker eastward until it reaches a thickness of nearly 350 feet at Edenton. Beneath the Yorktown are Eocene deposits and basal Cretaceous strata. Little is known of the thickness of the Eocene deposits. They probably are as much as several hundred feet thick and underlie most of the northeastern quarter of the Coastal Plain. The Cretaceous deposits increase in thickness from a feather edge along the Fall Zone to 400 feet at Farmville, Pitt County, about 50 miles southwest of Rich Square, Northampton County, located on the Chowan River Basin-Roanoke River Basin Boundary Line. The Cretaceous deposits are probably thicker at the eastern edge of the area (central part of Gates County, along the Chowan River in Hertford County, and southeastern part of Bertie County).

In some parts of the western half of the area (Northampton County as far as the Chowan River Basin is concerned), moderate amounts of ground water are available in sand lenses of the Yorktown Formation. Yields of 300 or 400 gallons a minute are probably the most that can be expected, and at many places, much less will be obtained. As the formation thickens to the east, greater amounts can be obtained, and, along the eastern margin of the area, many individual wells yield 400 or 500 gallons a minute. The water from many of the wells is hard.

Wells at Winton, Gatesville, and Sunbury may obtain water from Eocene Strata. The water from these wells is usually soft sodium-bicarbonate water, and is high in fluoride.

Cretaceous strata in the western part of Northampton County will yield only small to moderate amounts of water to wells. These strata become better producers toward the east. Yields of 200 to 500 gallons per minute probably can be obtained throughout most of the western half of Unit-Area 3, except in the strip just east of the Fall Zone, and as much as 500 to 1,000 gallons a minute from wells in the eastern half of the area. The water from the shallower beds is moderately hard and may be somewhat corrosive. That from the deeper beds is soft and generally non-corrosive.

Formations of the Coastal Plain and their Water-Bearing Properties - The formation of the Coastal Plain of North Carolina include the Patuxent and Tuscaloosa Formations (basal Cretaceous beds); Black Creek Formation (Upper Cretaceous age); Peedee Formation (youngest Cretaceous formation); Lower Eocene Deposits, Castle Hayne Marl (Upper Eocene age); Trent Marl (lying upon the eroded surface of the Castle Hayne Marl, and eastward thereof, passing beneath the Duplin and Yorktown formations of Upper Miocene age); Yorktown formations (Upper Miocene age); Duplin Marl (equivalent in age to the upper part of the Yorktown Marl and now occuring only in isolated patches); Waccamaw Formation and Croatan Sand (Pliocene formations cropping out along the Neuse River and south thereof); and seven Pleistocene formations, belonging to the Columbia group. The water-bearing properties of these formations are set forth in the following table.

| Formations | Water-Bearing Properties | |
|---|---|---|
| | Yield | Characteristics |
| Patuxtent and Tuscaloosa | 35-1000 g.p.m. | Low in total dissolved solids--considerable iron and carbon dioxide--often corrosive--soft in most wells--moderately hard to hard in some wells |
| Black Creek | 50-860 g.p.m. | Soft in most wells--low in total dissolved solids--Sometimes has considerable carbon dioxide, is corrosive, and contains an objectionable amount of iron |
| Peedee | 80-1800 g.p.m. | Usually moderately hard to hard--Sometimes contains considerable chloride |
| Castle Hayne Marl | 180-1000 g.p.m. | Usually hard--Sometimes contains objectionable iron |
| Trent Marl | 235 g.p.m. (average) | Hard at nearly all places--Sometimes contains objectionable iron |
| Yorktown | 285 g.p.m. (average) | Generally hard--high chloride content in outer half of Coastal Plain |
| Duplin Marl | Shallow domestic supplies--no Municipal supplies being obtained | Generally hard--sometimes contains objectionable iron |
| Waccamaw Formation and Croatan Sand | 150-200 g.p.m. (average) | Generally moderately hard |
| Columbia Group | 5-60 g.p.m. | Usually very soft--low indissolved solids, often contains objectionable iron, and may be very corrosive |

Records of Wells--The following table contains information regarding wells in the Chowan River Basin, which was taken from records of wells therein.

| Location | Owner | Depth (feet) | Diameter (inches) | Principal Formation | Yield (g.p.m.) | Hard-ness | Chloride |
|---|---|---|---|---|---|---|---|
| Bertie County | | | | | | | |
| Aulander | Town, 7 wells | 135-187 | 3 & 2 | Cretaceous | 15 (av.) | 168 | 5-28 |
| Colerain | Town | 270 | 8 | Yorktown | 65 | 142 | 4 |
| Chowan County | | | | | | | |
| Edenton | Town, Freemason St. | 290 | 12 | Yorktown | 650 | 195 | 110 |
| Edenton | Town, Virginia Road | 358 | 10-8 | Yorktown | 500 | 204 | 116 |
| Edenton | Town, at Power Plant | 212 | 8 | Yorktown | 200 | 210 | 120 |
| Edenton | Naval Air Base | 40 | 6 | Pleistocene | 40 | 47 | 16 |
| Edenton | Naval Air Base | 420 | 8 | Yorktown | -- | -- | --- |
| Edenton | Naval Air Base | 269 | 8 | Yorktown | 250 | 330 | 710 |
| Gates County | | | | | | | |
| Gatesville | Ice & Coal Company | 450 | 4 | Cretaceous? | 30 | -- | -- |
| Gatesville | Gatesville Hotel | 455 | 3 | Cretaceous? | -- | 14 | 156 |
| Sunbury | School | 350 | 3 | Eocene? | -- | 14 | 60 |
| Hertford County | | | | | | | |
| Ahoskie | Town, 2 wells | 290 | 8 | Eocene? | 250 ea. | 54 | 7 |
| Murfreesboro | Town | 228 | 3 | Cretaceous | 50 | 10 | 6 |
| Winton | Town | 155 | 6 | Cretaceous? | 50 | 20 | 21 |
| Northampton County | | | | | | | |
| Jackson | Town | 40 | 1.25 | Pleistocene | 75 | -- | -- |
| Rich Square | Town | 100 | 8 | Cretaceous | 140 | 10 | 2 |
| Rich Square | Town | 70 | 8 | Yorktown | 120 | 21 | 11 |
| Seaboard | Town | 154 | 8 | Cretaceous | 46 | -- | -- |
| Seaboard | Town | 85 | 8 | Cretaceous | 60 | 21 | 4 |
| Woodland | Town | 264 | 8 | Cretaceous | 35 | 5 | 3 |
| Woodland | Town | 182 | 8 | Cretaceous | 60 | -- | -- |

## CHAPTER VIII - QUALITY OF WATER

Suitability of Water - An adequate supply of water of good chemical and physical quality is not only one of North Carolina's most important natural resources but is one of the State's most valuable assets. Water of good quality is necessary for industry, public supplies, agriculture, domestic uses, recreation, and all forms of fresh-water life. Industry is constantly demanding additional data on the quality of surface waters in North Carolina. As population increases, municipalities must develop either a larger or new source of supply to meet the demand. Knowledge of chemical and physical characteristics is as important as quantity available in locating industrial sites or public-water supplies.

It must be realized that water, even though sometimes available in enormous quantities, may not always be suitable for a particular industry or a public supply. Water that is suitable for one industry may be entirely unsatisfactory for another. Water for such uses as hydroelectric-power generation, cooling towers, and air conditioning may contain relatively high mineral content without serious effects, but water to be used in paper manufacturing, textile industries, and many other processes must meet the most exact specifications. For example, more than 0.3 part per million of iron and manganese will discolor white paper or textile products enough to render them unsuitable for the market.

Normally, North Carolina is fortunate in having ample rainfall. Precipitation percolates through the relatively insoluble rocks and minerals, and enters the streams as soft surface water that is low in mineral content. Only a minimum amount of treatment is necessary to render it suitable for practically all industrial uses. Wise planning is necessary in order that the streams of North Carolina may continue to flow with water of good chemical and physical characteristics. As the population increases, greater industrial expansion is expected, and lumbering and agricultural activities will increase. These increased activities will have a tendency to create a greater burden on the streams either by increased pollution or as products of soil erosion entering the streams as suspended sediment. It is, therefore, important that a continuous check be kept on the chemical and physical characteristics of North Carolina streams in order to have this data available for industry, public water-supplies, agriculture, and other uses.

Chemical Quality - Factors influencing chemical and physical character of surface waters are dependent principally on the rainfall, geology, and pollution in the region. Small quantities of dissolved matter are brought to the earth in rain water. As the rain water descends toward the earth, carbon dioxide and other acid-forming gases are absorbed in the water, thus increasing the solvent action upon rocks and soils. The amount of materials dissolved by rain water after it reaches the earth depends on the additional solvent action it gains by percolating through carbon dioxide, rich soils, the nature of the rocks with which the water comes in contact, and the duration of contact. During periods of heavy rainfall, the runoff is generally rapid, and the time of contact with the rocks and soils is relatively short. The surface water, therefore, will usually contain smaller quantities of mineral matter and larger amounts of suspended sediment than during dry periods when stream flow is principally due to ground-water inflow. Pollution, another factor affecting the chemical quality of water, may occur by the addition of industrial, municipal, or domestic wastes. In the tidewater regions of the Coastal Plain, the chemical quality of surface waters varies with the tide and the extent of salt-water

intrusion. Color in objectionable amounts is often found in many of the streams.

Quality of Water Standards - Water-quality requirements for industry are so varied that it is impossible to establish specifications to fit all of them. Each industry usually has its own tolerances for the particular product manufactured. In general, however, most industries require water free from color, turbidity, and suspended matter, and low in hardness, manganese and iron.

Unlike waters used by industry, chemical specification have been accepted generally for waters used domestically. These chemical specifications are independent of any sanitary specifications established for protection of the public health. In 1946, the U. S. Public Health Service established chemical specifications for drinking water used on interstate carriers. Some of the specifications are as follows:

| | |
|---|---|
| Lead | Not to exceed 0.1 ppm |
| Fluoride | Not to exceed 1.5 ppm |
| Iron and manganese together | Not to exceed 0.3 ppm |
| Magnesium | Not to exceed 125 ppm |
| Chloride | Not to exceed 250 ppm |
| Sulfate | Not to exceed 250 ppm |

Waters, containing less than 500 ppm of dissolved solids, generally are satisfactory for most domestic and industrial uses. However, an excessive amount of iron or hardness or other undesirable constituents may cause difficulty in some cases. Waters with more than 1,000 ppm of dissolved solids are likely to include certain constituents that make them unsuitable for domestic or industrial uses.

In addition to the chemical specifications for public water-supplies, there are certain physical characteristics that should be considered. Turbidity color, odor, and taste are objectionable and should be held to a minimum. Physical characteristics recommended by the U. S. Public Health Service are as follows: turbidity should not exceed 10 ppm, color should be 20 or less on the platinum-cobalt scale, and no objectionable taste or odor shall be present.

Miscellaneous Analyses of Surface Waters - Chemical analyses, in parts per million, at various points on streams in the Chowan River Basin, taken from annual publications of Bulletin 52, North Carolina Department of Conservation and Development, "Chemical and Physical Character of Surface Waters of North Carolina", prepared cooperatively by the Geological Survey, United States Department of the Interior, are set forth in the tables on the following pages.

Quality of Ground Waters in the Coastal Plain - The ground waters in the Coastal Plain have three important constituents (chloride, iron, and fluoride) and two important chemical characteristics (hardness and corrosiveness) that affect the quality of the water, some of which cause serious problems in parts of the Coastal Plain.

Chloride - This chemical constituent is largely present as sodium chloride, or common salt. The usual chloride content of uncontaminated surface water and shallow ground water ranges from a few parts per million along the Fall Zone (contact between the Piedmont Plateau and the Coastal Plain) to as much as 40 parts per million along the coast. Water with less than 250 parts per million

| PHYSICAL AND CHEMICAL CHARACTERISTICS | Ahoskie Creek at Ahoskie, 1-22-47 | Ahoskie Creek at Ahoskie, 8-11-49 | Ahoskie Creek at Ahoskie, 12-13-49 | Ahoskie Creek at Ahoskie, 3-8-50 | Ahoskie Creek at Ahoskie, 4-19-50 | Ahoskie Creek at Ahoskie, 8-26-50 | Bennetts Creek near Gatesville, 8-12-49 | Bennetts Creek near Gatesville, 12-13-49 | Bennetts Creek near Gatesville, 4-19-50 | Bennetts Creek near Gatesville, 8-3-50 | Bennetts Creek near Gatesville, 6-5-51 | Chowan River near Edenton, 3-19-46 | Chowan River at Colerain, 1-22-47 | Chowan River at Chowan-Bertie County Line near Edenton, 2-24-49 | Chowan River at Winton, 1-22-47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Silica | 6.6 | 8.9 | - | - | - | - | 18 | - | - | - | - | 6.9 | 10 | 9.3 | 7.7 |
| Iron | 0.01 | 0.22 | - | - | - | - | .04 | - | - | - | - | .48 | .02 | .29 | .02 |
| Calcium | 3.2 | 2.7 | - | - | - | - | 3.8 | - | - | - | - | 4.0 | 4.6 | 4.2 | 4.0 |
| Magnesium | 1.6 | 0.7 | - | - | - | - | 1.2 | - | - | - | - | 1.3 | 1.4 | 1.0 | 1.4 |
| Sodium and potassium | 3.7 | 2.2 | - | - | - | - | 2.5 | - | - | - | - | 4.5 | 7.2 | 5.1 | 4.3 |
| Bicarbonate | 9.0 | 8.0 | 8.0 | 8.0 | 15 | 7.0 | 10 | 10 | 14 | 10 | 13 | 15 | 17 | 14 | 13 |
| Sulfate | 6.5 | 3.1 | 4.0 | 6.0 | 2.0 | 24 | 5.8 | 6.0 | 2.0 | 1.0 | 5.0 | 5.5 | 6.6 | 5.8 | 7.2 |
| Chloride | 6.0 | 2.8 | 9.0 | 9.5 | 5.0 | 3.5 | 3.5 | 9.8 | 10 | 4.8 | 11 | 4.8 | 8.5 | 4.8 | 4.8 |
| Fluoride | 0 | 0.1 | - | - | - | - | 0.1 | - | - | - | - | 0 | 0 | 0.2 | 0 |
| Nitrate | 0.2 | 0.6 | - | - | - | - | 0.6 | - | - | - | - | 0.3 | 0.2 | 1.0 | 0.2 |
| Dissolved solids | 59 | 50 | - | - | - | - | 65 | - | - | - | - | 40 | 60 | 53 | 53 |
| Total hardness | 15 | 10 | 13 | 11 | 16 | 16 | 14 | 15 | 18 | 10 | 28 | 15 | 17 | 15 | 16 |
| Specific conductance * | - | 32 | 55.3 | 57.2 | 67.3 | 67.2 | 19.6 | 70.6 | 74.9 | 46.2 | 71.6 | - | - | 56.7 | - |
| pH | 5.5 | 6.7 | 6.2 | 6.2 | 6.1 | 5.8 | 5.5 | 6.3 | 6.3 | 5.8 | 6.5 | - | 6.5 | 6.5 | 6.0 |
| Color | 90 | 75 | - | - | - | - | 65 | - | - | - | - | 62 | 45 | 23 | 56 |

*micromhos at 25 deg. C.

| PHYSICAL AND CHEMICAL CHARACTERISTICS | Dillard Creek near Meege Cross Roads, 2-25-49 | Duke Swamp near Sunbury, 8-11-52 | Meherrin River near Margarettesville, 1-22-47 | Meherrin River near Severn, 1-22-47 | Meherrin River near Severn, 10-19-49 | Meherrin River near Severn, 1-17-50 | Meherrin River near Severn, 3-8-50 | Meherrin River near Severn, 4-18-50 | Meherrin River near Severn, 8-26-50 | Meherrin River at Murfreesboro, 1-22-47 | Potecasi Creek at Potecasi, 8-11-49 | Potecasi Creek at Potecasi, 12-13-49 | Potecasi Creek at Potecasi, 4-18-50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Silica | 2.8 | - | 11 | 13 | 18 | 16 | 15 | - | 16 | 9.3 | 10 | - | - |
| Iron | .19 | - | .02 | .04 | .07 | .07 | .11 | - | .32 | .02 | 1.5 | - | - |
| Calcium | 5.4 | - | 3.4 | 3.5 | 5.8 | 4.2 | 4.8 | - | 5.3 | 4.1 | 3.2 | - | - |
| Magnesium | 1.6 | - | 1.6 | 1.5 | 2.3 | 1.9 | 2.0 | - | 2.0 | 1.5 | 1.2 | - | - |
| Sodium and potassium | 4.8 | - | 4.4 | 5.7 | 7.1 | 7.1 | 6.6 | - | 6.0 | 4.5 | 2.2 | - | - |
| Bicarbonate | 11 | 15 | 16 | 18 | 37 | 28 | 29 | 34 | 26 | 16 | 10 | 10 | 13 |
| Sulfate | 9.5 | 2.0 | 5.8 | 5.6 | 2.8 | 3.5 | 3.7 | 3.0 | 4.9 | 6.3 | 3.3 | 2.0 | 1.0 |
| Chloride | 8.2 | 8.0 | 3.8 | 4.5 | 4.2 | 4.8 | 4.5 | 4.5 | 4.5 | 4.5 | 3.8 | 7.0 | 6.2 |
| Fluoride | 0 | - | 0 | 0 | 0 | 0 | 0.1 | - | 0.1 | 0 | 0.2 | - | - |
| Nitrate | 0.1 | - | 0.3 | 0.3 | 0.3 | 0.4 | 0.3 | - | 1.0 | 0.2 | 0.1 | - | - |
| Dissolved solids | 59 | - | 48 | 51 | 60 | 54 | 54 | - | 58 | 50 | 58 | - | - |
| Total hardness | 20 | 21 | 15 | 15 | 24 | 18 | 20 | 21 | 21 | 16 | 13 | 8 | 10 |
| Specific conductance * | 70.1 | 66.2 | - | - | 76.0 | 71.8 | 71.0 | 85.4 | 77.4 | - | 35.5 | 39.0 | 48.0 |
| pH | 6.0 | 5.7 | 6.1 | 6.1 | 6.6 | 6.5 | 6.2 | 6.8 | 6.6 | 6.1 | 6.0 | 6.2 | 5.9 |
| Color | 75 | - | 35 | 35 | 10 | 5 | 8 | - | 12 | 38 | 90 | - | - |

*micromhos at 25 deg. C.

| PHYSICAL AND CHEMICAL CHARACTERISTICS | Potecasi Creek at Potecasi, 9-4-50 | Potecasi Creek near Winton, 1-22-47 | Potecasi Creek near Woodland, 1-22-47 | Ramsey Creek at Jackson, 1-22-47 | Rockyhock Creek at Valhalla, 2-24-49 | Salmon Creek near Edenhouse, 2-24-49 | Wiccacon River near Harrelsville, 1-22-47 |
|---|---|---|---|---|---|---|---|
| Silica | - | 6.7 | 6.1 | 7.6 | 6.0 | 7.6 | 7.0 |
| Iron | - | .05 | .02 | .25 | .22 | .05 | .01 |
| Calcium | - | 3.1 | 3.2 | 3.0 | 9.2 | 5.9 | 3.8 |
| Magnesium | - | 1.2 | 1.2 | 1.0 | 1.7 | 1.2 | 1.5 |
| Sodium and potassium | - | 4.9 | 4.0 | 5.9 | 5.5 | 3.0 | 4.1 |
| Bicarbonate | 13 | 9.0 | 9.0 | 10 | 23 | 12 | 9.0 |
| Sulfate | 1.0 | 6.5 | 5.3 | 6.0 | 9.6 | 4.9 | 7.2 |
| Chloride | 4.0 | 6.4 | 6.2 | 6.9 | 9.1 | 7.5 | 6.8 |
| Fluoride | - | 0 | 0 | 0 | 0 | 0.2 | 0 |
| Nitrate | - | 0.2 | 0.2 | 0.2 | 0.3 | 0.2 | 0.2 |
| Dissolved solids | - | 57 | 51 | 51 | 75 | 63 | 62 |
| Total hardness | 13 | 13 | 13 | 12 | 30 | 20 | 16 |
| Specific conductance * | 46.0 | - | - | - | 90.8 | 60.5 | - |
| pH | 6.0 | 5.6 | 5.3 | 5.7 | 6.3 | 6.0 | 5.6 |
| Color | - | - | 75 | 45 | 90 | 50 | 90 |

* micromhos at 25 deg. C.

of sodium chloride has only a very slightly salty taste. At a concentration of about 500 parts per million, a salty taste is generally noticeable, and it is doubtful whether water with more than that amount of chloride would be generally acceptable except for short periods. A number of towns, cities, and industries in North Carolina use water with a chlorine content of 250 to 500 parts per million.

Connate and intrudent water - Water with an abnormally high chloride content originates in two general ways: (1) as water that was trapped in the sediments at the time of their deposition or entered them during a later submergence, and (2) by comtemporaneous contamination from a nearby underground or surface body of salty water.

Sea water that was trapped in the sediments at the time of their deposition is known as connate water. Subsequent to its entrapment, the water may undergo considerable change or may be greatly diluted, or both, but is still considered connate water, even though greatly modified, if the outstanding chemical characteristics of the water are due to the original sea water.

Sea water that has entered the strata at some subsequent date (after deposition of the strata) due either to later submergence of the land, or to a reversal of movement of the water in the acquifer so that sea water enters the acquifer where it crops out in the sea, may be termed "intrudent water". Like connate water, intrudent water is greatly changed from its original character. Connate and intrudent waters are both fossil waters. Water drawn in by pumping is not considered to be intrudent water.

Only in local areas has connate and intrudent water been encountered in the inner part of the Coastal Plain, and, in these areas, the chloride content is not more than a few hundred parts per million. Almost everywhere in the outer part, however, they have been encountered at some depth. Where such salty water is once reached in any well, the chloride content apparently increases very rapidly with increasing depth of the well. At Edenton, the stratum at 212 to 220 yields water with a chloride content of not more than 100 parts per million. At 230 feet the chloride content is about 700 parts per million. A test well at the Marine Air Corps Station, 4.5 miles southeast of Edenton, yielded water with a chloride content of 900 parts per million at 250 feet, 2400 parts at 290 feet, and 3000 parts at 420 feet.

Chloride contamination - In a few wells, the chloride content has increased as the well was pumped. This increase can occur (1) by lateral encroachment from a nearby body of salty water, (2) by contamination from below, or (3) by pollution from organic sources.

Contamination by local encroachment from a nearby body of salty water has occurred in the wells supplying the City of New Bern and in industrial wells in the City of Wilmington.

Contamination from below may occur if a shallow well is pumped sufficiently to lower the head on the fresh water to sea level, causing the salt water to rise or "cone up" beneath the well. If the pumping level is maintained at such a level for a sufficient length of time, salt water will be drawn into the well.

In the case of an abnormal content caused by pollution from organic

sources, the high chloride content is usually accompanied by high nitrates. A number of shallow wells in populated areas have shown indications of such pollution.

Iron - Some wells in nearly every part of the Coastal Plain yield water with objectionable amounts of iron, and it is probable that objectionable amounts of iron impair the value of more ground-water supplies than all other chemical factors combined. The principal objection to the presence of iron is that it causes staining of enamel ware and other utensils, bathroom fixtures, and clothing. Water with 0.2 part per million may cause some staining.

Iron in some form is present in practically all soils and rocks and may be dissolved by ground water. The presence of iron in ground water is seemingly erratic, and, of two wells only a few hundred yards apart and about the same depth, one will have a high iron content, whereas the other will have little or no iron. Generally, the deeper water has a lower iron content than the shallow water. The average iron content is shown in the following table.

AVERAGE IRON CONTENT OF WELLS BETWEEN SPECIFIED DEPTHS

| Range in depth (feet) | 0-50 | 51-100 | 101-150 | 151-200 | Above 200 |
|---|---|---|---|---|---|
| Iron (parts per million) | 2.2 | 1.14 | 1.23 | 0.75 | 0.51 |

Iron can be removed simply in a treatment plant and, therefore, presents no insurmountable problem to the larger municipalities. Treatment is relatively more expensive for small municipalities and industries, and is especially so for domestic supplies.

Fluoride - This chemical constituent, in water in excess of about one part per million, may cause the dental defect known as mottled enamel, if the water is used for drinking and cooking during the formation of the teeth, which will erupt, showing a dull, chalky-white appearance and later taking on a brown stain. The surface of the teeth may also be marked by pitting. The mildest forms of mottled enamel will develop in about 10 percent of the children who continually use water with a fluoride content of about one part per million. The severity and percent of incident increases markedly with an increase in fluoride content until, at 6 parts per million, an incidence of 100 percent is not unusual, and a large percentage of cases are classed as moderate or worse. Mottled enamel is a permanent physical disfigurement. The teeth of children only are affected. Normally, calcified teeth do not become mottled later, regardless of the fluoride content of the drinking water.

Water containing small amounts of fluoride, however, is reported to be beneficial in prevention of dental decay. It has been shown that school children, using water containing about one part per million of fluoride, experience only one-half to one-third as much dental decay as comparable groups using water that contains no fluoride.

The following table is taken from a survey by the U. S. Public Health Service and covers wells in the Chowan River Basin which had, at the time of the survey, a fluoride content of one part per million or more.

In the following table, fluoride in excess of one part per million was found only in wells 100 or more feet deep.

| County | Location | Ownership | Depth (feet) | Parts Per Million: Fluoride | Bicarbonate | Total Hardness |
|---|---|---|---|---|---|---|
| Bertie | Windsor | Town (municipal supply) | 334 | 3.0 | 432 | 18 |
| Bertie | Windsor | Town, near Esso Service Station | 325 | 3.8 | 404 | - |
| Chowan | Edenton | Freemason St. well | 291 | 1.6 | 670 | 176 |
| Gates | Gatesville | Hotel | 455 | 1.7 | 477 | 14 |
| Gates | Sunbury | School | 350 | 4.0 | 657 | 14 |
| Gates | Roduco | E. D. Eure | 155 | 1.0 | 471 | 82 |
| Hertford | Winton | Town | 180 | 2.1 | 291 | 20 |
| Northampton | Rich Square | Town | 100 | 1.3 | 24 | 10 |

Hardness - This chemical characteristic of water is due to the presence therein of certain compounds of calcium and magnesium, usually the carbonates, bicarbonates, and sulfates, and occasionally chlorides or nitrates. Hardness of water is objectionable because it destroys soap, thus requiring a large amount thereof to produce a lather, and because of the scale formed by the precipitation of the minerals on the walls of any container in which the water is heated.

Hardness of the ground water in the Coastal Plain of North Carolina is usually due to the solution of calcium and magnesium carbonates by the water as it percolates downward through soils containing calcium. Occasionally, part of the hardness is due to sulfates. Hardness rarely occurs because of chlorides or nitrates. When sulfate is present in sufficient amount to cause any appreciable amount of hardness, the chloride content is usually above normal. The source of sulfate and chloride in such waters is evidently connate water. The shallow water in Bertie, Hertford, and Northampton Counties, and in the western part of Gates County is usually soft. In some areas of Chowan County and the eastern part of Gates County, the shallow water is as hard as the deep water.

Corrosiveness - Oxygen and carbon dioxide are the principal constituents of ground water which cause the chemical characteristic known as corrosiveness. Shallow ground water is usually more corrosive than the deeper water. As the water percolates downward, the oxygen therein is quickly used up in the combination of it with organic and inorganic materials in the soils and rocks. The carbon dioxide commonly reacts with carbonates to form bicarbonates. Because of this reaction, hard water is generally less corrosive than water of low mineral content and hardness.

Corrosion causes deterioration of the well casing, pump pipes, tanks, and water pipes in the distribution system. This deterioration is not as objectionable, however, as is the presence of the iron which is dissolved, causing "red water" that stains utensils, plumbing fixtures, and laundry. It is not always apparent whether the iron is in the water when it enters the well, or whether it has been dissolved by corrosion of the well casing and pipes. The problems of iron and corrosiveness in ground water are closely related, and both are serious problems for domestic, and small municipal and industrial, users in the Coastal Plain.

## CHAPTER IX--ABATEMENT OF STREAM POLLUTION

Action by the State Stream Sanitation Committee--A study of the water uses within the Chowan River Basin has been made by the North Carolina State Stream Sanitation Committee, the agency responsible for abatement of stream pollution. To determine the significant contributors of pollution into the waters of the basin, a systematic investigation of all sources, both municipal and industrial, was conducted. This procedure involved the determination of the volumes and characteristics of all sewage and industrial wastes, either treated or untreated, that were being discharged into the waters of the basin. In addition, the survey included conferences with County Health Officers, Wildlife Protectors, Soil Conservation officials, County Farm Agents, and others concerning the usage of water within the basin.

Sampling Stations and Procedures--The survey included a program of stream sampling from the North Carolina-Virginia State Line to the mouth of the Chowan River in Albemarle Sound and extending throughout the major tributaries in the Basin, with particular emphasis on those streams receiving significant pollution loads. Following the general survey of locating and determining the amounts and general characteristics of the pollution, sampling stations were set up. These were located so as to have one a short distance above the source of pollution, and, where feasible, several below the source of pollution.

Samples were collected from the streams after the wastes had had opportunity for dilution and mixture with the receiving waters, and in such manner as would provide a reasonable sample. The methods of sampling were varied to fit individual conditions and the types of materials being sampled. Sampling operations were conducted in accordance with the procedures and methods outlined in "Standard Methods for Examination of Water and Sewage, Ninth Edition", published jointly by the American Public Health Association and the American Water Works Association. Special equipment was utilized to collect stream samples in conformity with standard procedures. Collecting devices prevented aeration of dissolved oxygen and B. O. D. (biochemical oxygen demand) samples while they were being collected. Apparatus and chemical reagents in appropriate field kits were used by the survey crews for the determination of dissolved oxygen and water temperature. Other physical features of the stream were recorded at the time of sampling. Sampling stations were also established on certain streams that were known to be free of appreciable sewage and industrial pollution. The results of the samples collected from these sampling stations were used in establishing a base line of stream quality in the general area.

Hydrological Measurements--Since accurate data regarding stream flows at sampling times are essential, a program of cooperation with the Raleigh office of the United States Geological Survey was established. One of the major functions of this Federal agency is collecting streamflow data. Their regularly operated streamflow-measurement stations were utilized, and a network of secondary flow-measurement sites was established. Within the Basin, there were five regular stations and 19 sites at which stage observations were obtained by manual devices. In addition, there were a number of locations at which special methods were used to obtain flow data. In general, following the selection of a sampling site, the vicinity was investigated for the location that would provide the best stage-discharge relation. Then, at intervals during the sampling period, flow measurements were obtained to cover the range found in sampling. The cross-sectional area of the stream was found by means of a current meter. The stream flows were calculated from these data.

Laboratory Tests and Their Significance--When sampling a stream, certain tests must be made in the field at the time of sampling such as temperature, dissolved oxygen, and certain observations connected with the senses of sight and smell. Other tests are run in the mobile laboratory such as hydrogen-ion concentration (pH), alkalinity, hardness, chlorides, biochemical oxygen demand (B. O. D.), and most probable number (M.P.N.) of coliform bacteria. Other portions of the samples are packed in ice in special containers and shipped to the State Laboratory of Hygeiene in Raleigh for such special tests as suspended solids, dissolved solids, total solids, turbidity, color, ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, and sulfate.

The laboratory data are used by the State Stream Sanitation Committee in classifying and assigning standards of quality and purity to designated waters in North Carolina. For each class of water designated, there are accompanying standards of water quality and purity which shall be applied thereto. A brief discussion of the significance of the data obtained from these laboratory data follows.

The temperature of stream waters is useful in indicating the solubility of gases in it and, hence, the saturation level of dissolved oxygen; the effect of temperature on biological activities; and the effect of visocosity on sedimentation. Temperature has a marked influence on the rates of natural purification due to biological activity, which is greater at higher temperatures and diminishes at lower temperatures. As temperature rises, visosity decreases with a resulting increase in sedimentation, provided that other factors do not interfere.

Turbidity is an index of the density of the suspended matter in a sample.

The color of water provides an indication of substances in solution, including microscopic plant growths, organic materials, and certain industrial wastes.

The hydrogen-ion concentration (pH) is a measure of its acidity or alkalinity. Water having a pH value of 7.0 is neither acid nor alkaline. Higher values indicate the presence of alkaline earth salts, and lower values indicate the presence of acid or acid salts. In North Carolina, the pH in most of the streams unaffected by sewage and industrial wastes will vary from about 6.0 to 7.5. With respect to normal fish life in streams of the State, the pH value should be within the limits of 4.3 to 8.5.

The alkalinity of natural water represents its content of carbonates, bicarbonates, hydroxides, and sometimes borates, silicates, and phosphates. Within normal limits, the alkalinity and hydrogen-ion concentration have little sanitary significance. They are, however, of value in handling industrial wastes and in controlling the various waste-treatment processes.

The amount of oxygen dissolved in water is one of the most valuable analytical measures of the condition of a given water. Dissolved oxygen is essential to the natural purification of stream water, and the maintenance of fish and other aquatic life. In natural streams, the dissolved oxygen is used to support the biochemical oxidation of organic wastes. It tends to be replaced by absorption from the atmosphere and the photosynthetic action of certain green

plants. A deficiency in the dissolved-oxygen content of a polluted stream below the saturation level which is the condition at which it contains as much oxygen as it can dissolve, indicates the presence of polluting substances which are using up the oxygen from the stream water. The degree of this deficiency is a measure of the deoxygenating effect of the particular wastes, and hence an index of the degree of pollution present in the stream. In North Carolina, studies indicate that an oxygen minimum of five parts per million is necessary to support trout adequately and four parts per million for other forms of game fish.

The biochemical oxygen demand (B.O.D.) test is the most important test made in sanitary analyses to determine the polluting power, or strength, of sewage or polluted water. It serves as a measure of the amount of clean diluting water, or degree of treatment, required for the successful disposal of the polluting substance. The biochemical oxygen demand is a measure of the amount of dissolved oxygen that may be expected to be absorbed from a stream in five days at 20 degrees Centigrade in order to satisfy the biological and chemical oxidation of the organic pollutants carried in the stream at the time of sampling. In general, a stream with slight to moderate pollution will have an average B. O. D. of less than three parts per million. In moderately polluted streams, the B. O. D. range is usually between three and five parts per million, while in grossly-polluted streams the B. O. D. will be in excess of five parts per million.

The coliform-bacteria content is used as a general index of the sanitary condition of a stream. This determination shows the approximate density of a group of bacteria which are always present in large numbers in sewage, and are relatively few in numbers in other stream pollutants. The most important use of the coliform-bacteria content is evaluation of the water as a source of raw water for public water supplies, and its uses for bathing purposes and shellfish culture.

Significant Pollution-- There are 25 points of significant pollution within the North Carolina portion of the basin. The wastes causing pollution consist of domestic sewage, industrial wastes, and combinations of these two types of wastes. The total estimated volume of wastes discharged from these points excluding wastes from commercial fisheries, is approximately 800,000 gallons per day of which approximately 93 per cent is domestic sewage and approximately seven per cent is industrial waste. Three major sources of significant pollution, not included in the above figures, are the Blackwater, Nottoway, and Meherrin Rivers, which discharge into North Carolina wastes from Virginia that have an estimated domestic sewage population equivalent of 50,980.

The wastes from these points of significant pollution, excluding wastes from commercial fisheries and wastes from Virginia in the Blackwater, Nottoway, and Meherrin River, have an estimated domestic sewage population equivalent of 15,633. Approximately 80 per cent of the above non-excluded wastes is domestic sewage, and industrial wastes comprise approximately 20 per cent. After these wastes pass through various treatment processes, ranging from no treatment to complete treatment, the wastes discharged to the streams have an estimated domestic sewage population equivalent of 14,458, indicating that the total over all waste reduction is only eight per cent.

About 61 per cent of the wastes discharged to the streams receive no treatment. Two communities, Edenton and Murfreesboro, discharge wastes

into streams without treatment. The community of Ahoskie discharges into Ahoskie Creek, without treatment, domestic wastes from approximately one-half of its population in addition to wastes from two small industrial establishments.

The total estimated domestic sewage population equivalent of the wastes discharged from Virginia into North Carolina via the Blackwater, Nottoway, and Meherrin Rivers is approximately four times the estimated domestic sewage population-equivalent of the wastes discharged in North Carolina.

Significant Sources of Pollution

N. C.-Virginia State Line to Mouth of Meherrin River--Communities in Virginia that contribute domestic waste to the Blackwater River are Franklin, Wakefield, and Waverly. Manufacturing concerns that contribute industrial waste are Camp Manufacturing Company (pulp and paper), located at Franklin, and Pocahontas Poultry Farm, located at Wakefield. These communities and industries discharge wastes to Blackwater River which is estimated to have a total B. O. D. load that is equivalent to raw sewage from a domestic population of 96,000 people.

Sources in Virginia that contribute domestic wastes to the Nottoway River are Jarrett, McKenny, Piedmont Sanatorium, Southampton, Farms (Penitentiary), and Victoria. Johns Manville Products Corporation (building board), located at Jarrett, is the only major source of industrial waste. The combined wastes from these sources are estimated to comprise a total B. O. D. load in the Nottoway River that is equivalent to domestic sewage from a population of 9,000 people.

Communities in Virginia that contribute domestic wastes to the Meherrin River are Boykin, Emporia, Holland, Kenbridge, Lawrenceville, and Saint Paul's Polytechnic Institute. The only contributor of industrial waste is the Virginia Dyeing Corporation, which is a textile industry located at Emporia. Total waste loadings to Meherrin River from these sources are estimated to have a B. O. D. load that is equivalent to raw sewage from a domestic population of 25,000 people.

The above mentioned municipalities and manufacturing establishments, discharging waste materials, are located above the North Carolina-Virginia State Line ranging from 16 to 58 miles for the Blackwater River, from 57 to 123 miles for the Nottoway River, and from 4 to 87 miles for the Meherrin River. It is obvious, therefore, that the total pollutional load in the three streams in Virginia from these sources is materially reduced by the natural purification processes which take place in the streams between the points at which wastes are discharged and the North Carolina State Line. Tests at sampling stations, located on the three rivers in Virginia, indicate pollution loads reaching North Carolina in the Blackwater, Nottoway, and Meherrin Rivers of 3900, 3020, and 1500 pounds per day, 5-day B. O. D. at 25 degrees Centigrade, respectively.

The public sewerage system of the Town of Seaboard, Northampton County, serves 704 people and discharges the effluent from its primary treatment plant into Ivy Creek. The effluent from this plant has a population equivalent of 493 people and is significant only from the standpoint of local pollution in the receiving stream below the point of discharge.

The Kirby Chemical Company near Severn, Northampton County, discharges approximately 250 gallons of waste per day, containing 25 per cent of sodium

sulfate, into a natural lagoon located adjacent to Meherrin River. This lagoon has no outlet to the stream. There is, however, a possibility of pollution in the stream resulting from seepage or from washouts due to flood waters. There is also a possibility of pollution in the stream as a result of overflow or spillage during plant operation.

The Riverside Manufacturing Company discharges to Meherrin River untreated domestic sewage having an estimated population equivalent of 142 and industrial waste having an estimated population equivalent of 396. The total volume of waste amounts to about 12,000 gallons per day.

The public sewerage system of the Town of Murfreesboro, Hertford County, receives domestic waste from an estimated population of 1,800 people and industrial waste from a laundry having a population equivalent of 500 people. These wastes are discharged by means of two outfalls into Meherrin River without treatment. Stream studies on the Meherrin River in the vicinity of Murfreesboro indicate that wastes from the Town of Murfreesboro result in excessive pollution of Meherrin River and are a potential hazard from the standpoint of development of local nuisance conditions.

J. M. Brown and Son near Woodland, Northampton County, discharge a small amount of industrial waste into a small drainage ditch which flows into Urahaw Swamp, a tributary of Potecasi Creek. This waste amounts to about 4,000 gallons per day and has an estimated population equivalent of 216. The effects of this waste are limited to local pollution in Urahaw Swamp.

The Milwaukee Basket Company at Milwaukee, Northampton County, discharges a small amount of industrial waste into a small drainage ditch which flows into Potecasi Creek, a tributary of the Meherrin River. The effects of this waste is limited to local pollution in the upper reaches of Potecasi Creek.

The Town of Woodland had a 1950 population of 590 people and has no municipal sewer system. Plans are now under way for the construction of a sewerage system which will have provisions for adequate sewage treatment.

Talon, Inc., a manufacturing establishment at Woodland, has no industrial waste. The firm employs 185 people having an estimated domestic sewage flow of 4,000 gallons per day, which is being treated by a septic tank plus a filter trench, with the effluent discharging a small amount of sewage into a drainage ditch that flows to Urahaw Swamp. The pollution is significant only from the standpoint of local pollution below the point of discharge.

Mouth of Meherrin River to A. C. L. Railroad Bridge across Chowan River near Tunis--The Town of Winton is the only community in this area and provides the only source of significant pollution. It has a primary treatment plant that serves an estimated population equivalent of 604 people and discharges an effluent, having a population equivalent of 454, into the Chowan River. The conditions, observed by State Stream Sanitation Committee both at the plant and in the stream below the effluent, indicate that the plant is not being properly operated or maintained.

A. C. L. Railroad Bridge across Chowan River near Tunis to Mouth of Chowan River, excluding Beaches-- Excluding the commercial fisheries, there are seven significant sources of sewage and industrial-waste pollution, which

are being contributed to the waters in this section of the Basin. The total, as expressed in population equivalent based on biochemical oxygen demand, is estimated to be 3,800, of which 1,600 is due to industrial waste.

The public sewage system of the Town of Aulander, Bertie County, serves 650 people and discharges the effluent from its primary treatment plant into Fort Branch, a tributary of Ahoskie Creek. The effluent from this plant has a population equivalent of approximately 500 people and is significant only from the standpoint of local pollution in the receiving stream immediately below the point of discharge. However, the present primary treatment plant is overloaded and is not being properly operated or maintained.

The public sewerage system of the Town of Ahoskie, Hertford County, receives domestic waste from a population of 3,300 and industrial waste from a small laundry and a small milk-processing plant. The wastes from these two small industrial plants contribute a waste load having an estimated biochemical oxygen demand equivalent to raw sewage from a domestic population of 300 people. The load tributary to the system is, therefore, equivalent to domestic sewage normally expected from a population of 3,600 people. These wastes are treated by two small primary type treatment plants, the effluents of which discharge directly into Ahoskie Creek. The Southwest Plant serves a population of 1,980 and discharges an effluent, after treatment, having a population equivalent of approximately 1,500 people. The Southeast Plant serves a population of 1,320 people plus industrial waste having a population equivalent of 300. This plant, however, was not in service during the period of the recent survey by State Stream Sanitation Committee personnel, at which time sewage and industrial wastes, having a population equivalent of 1,620, were being discharged directly into Ahoskie Creek. The wastes from these plants result in excessive pollution of Ahoskie Creek and are a potential hazard from the standpoint of development of local nuisance conditions.

The Almar Pickle Company at Ahoskie processes and stores cucumbers in brine solutions before shipping to other points for manufacture of cucumber pickles. Seasonal waste, having a high salinity content, is discharged into a drainage ditch that flows to Horse Swamp, a tributary of the Wiccacon River. This waste is estimated to have a population equivalent of 1,146 people and a flow of 8,000 gallons per day. It is significant only from the standpoint of local pollution immediately below the point of discharge.

The Ahoskie Package Company discharges a small amount of industrial waste into a drainage ditch which flows into Horse Swamp. This waste amounts to about 2,000 gallons per day and has an estimated population equivalent of 120. The effects of these wastes are limited to local pollution in the small receiving stream.

The municipal sewerage system of the Town of Colerain, Bertie County, serves 365 people and discharges the effluent from a small primary treatment plant into a drainage ditch which flows into Chowan River. The pollution load, tributary to the drainage ditch, is estimated to have a population equivalent of 274. The conditions observed by State Stream Sanitation Committee personnel, both at the plant and in the stream below the effluent, indicate that the plant is not being properly operated or maintained. The waste from this treatment plant results in excessive pollution of Colerain Beach and is a potential hazard from the standpoint of injury to the health of the bathers.

Gates County Prison Camp No. 106, about three miles northeast of Gatesville, county seat, discharges treated sewage from a septic tank into a small branch, tributary to Bennetts Creek. The system serves 100 people and results in a sewage discharge, having an estimated population equivalent of 75, into the stream. The pollution is significant primarily from the standpoint of local pollution immediately below the point of discharge.

Chowan High School at Smalls Cross Roads, about 1.1 miles northwest of Edenton, Chowan County, has an enrollment of 500 students and domestic sewage flow of approximately 5,000 gallons per day. Waste is being treated by a septic tank, the effluent of which discharges sewage, having an estimated population equivalent of 38 into an unnamed stream that flows to Dillards Mill Pond, a tributary of Dillard Creek. Due to the fact that unorganized bathing takes place in Dillard Creek, the waste from this tank is a potential hazard from the standpoint of injury to the health of the bathers.

Mouth of Chowan River, including Edenton Bay and Adjacent Waters to a Line extending from the Mouth of Blackwater Swamp, Bertie County, to the North End of Norfolk-Southern Railroad Bridge across Albemarle Sound -- All pollution that originates in this area flows into Edenton Bay. In order to determine the water quality for Edenton Bay, chemical, biochemical, and bacterial sampling has been conducted by State Stream Sanitation Committee personnel at several selected points in the Bay.

Significant Sources of Pollution -- The significant sources of pollution in this area are the Town of Edenton, Westover Heights ( a sub-division located at Edenton), and Holland & Spivey Veneer Mill. The total sewage and waste discharges from these sources, excluding fish houses, are estimated as being equivalent to the raw domestic sewage from a population of 5,000.

The Town of Edenton is the largest source of municipal pollution in that portion of the Chowan River Basin within North Carolina. Raw sewage from 4,600 people and some industrial wastes are discharged through multiple outlets directly into Edenton Bay, and into Pembroke and Queen Anne Creeks. These discharges create sludge deposits and surface films, and result in the presence of organisms of the coliform group (sewage bacteria) far in excess of the maximum limits normally recommended for bathing and recreational uses.

The Westover Heights Sub-division, located about one mile west of Edenton, has a community sewerage collection system which discharges raw sewage through a single outfall line at a point approximately one-half mile above U. S. Highway 17 Bridge across Pembroke Creek.

The Woodland & Spivey Veneer Mill, located within the corporate limits of the Town of Edenton, discharges industrial waste having an estimated population equivalent of 218 people into a drainage ditch which flows through a residential area to Pembroke Creek. The total volume of waste amounts to about 4,000 gallons per day. This organic waste, due to lack of proper dilution, decomposes rapidly, creating odors and unsightly conditions.

The Edenton Bay Fish Company operates a fish-packing plant located at Edenton. This plant operates throughout most of the year. The major operation occurs, however, during the herring season. The main products of this plant are herring, rockfish, perch, shad, carp, and catfish. Plant operations consist of washing and cleaning, packing, and fish-roe canning. Edenton water is

used for cleaning of fish and fish roe. Offal in the form of fish solids are collected and rendered into fish meal. Domestic sewage, and industrial waste consisting of blood, wash water, and some fish solids, are discharged into Edenton Bay without treatment. These wastes produce surface films and other undesirable conditions, resulting in pollution problems in the vicinity of the plant.

Public Water Supplies-- The following table sets forth public ground-water supplies in the Chowan River Basin within North Carolina as of December 31, 1954, with indications of the treatment given thereto.

| Community | Population 1950 | Est. Population Served | Owner-ship | Est. Consumption M. G. D. | No. of wells | Est.Total Yield M. G. D. | Date Install-ed | Treat-ment |
|---|---|---|---|---|---|---|---|---|
| Ahoskie | 3,579 | 3,300 | M | 0.340 | 4 | 1.44 | 1919-29-48-53 | None |
| Aulander | 1,112 | 1,020 | M | 0.100 | 1 | 0.72 | 1925 | None |
| Colerain | 367 | 367 | M | 0.030 | 1 | 0.10 | 1939 | None |
| Conway | 618 | 665 | M | 0.020 | 2 | 0.32 | 1951 | Chlorinator-Fe-Removal-Filter-Aerator |
| Edenton | 4,468 | 4,600 | M | 0.283 | 2 | 1.58 | 1923-35 | Chlorinator-Zeolite Softening |
| Westover Heights* | Unknown | 140 | M* | 0.009 | 1 | 0.05 | 1949 | None |
| Murfreesboro | 2,140 | 2,250 | M | 0.112 | 2 | 0.58 | 1929-46 | None |
| Seaboard | 745 | 707 | M | 0.027 | 1 | 0.12 | 1941 | Fe Removal-Alum-Lime Rapid Sand Filter |
| Winton | 835 | 700 | M | 0.027 | 2 | 0.72 | 1936-48 | None |
| Woodland | 590 | 710 | M | 0.020 | 2 | 0.14 | 1941 | None |

* Owned and operated by Town of Edenton

## CHAPTER X -- WATERSHED MANAGEMENT

General--Information regarding water control, problems of watershed management, the Watershed Protection and Prevention Act (Public Law 566, 83rd Congress 2nd Session, approved August 4, 1954), the first annual National Watershed Congress (December 6 and 7, 1954), and the North Carolina Soil Conservation Districts Law (enacted by the 1937 Session of the General Assembly) may be found in Chapter XIII of Volume I of the inventory of water resources of North Carolina, which was authorized by the Council of State on October 11, 1954 and which is in process of preparation by the Department of Conservation and Development. Volume I, as indicated in the Foreword herein, was published in January 1955.

Soil Conservation Practices Accomplished and Contemplated--The data contained in the tables of "Soil Conservation Practices Accomplished" and "Soil Conservation Practices Contemplated", set forth below, were furnished by the State Conservationist, Soil Conservation Service, U. S. Department of Agriculture, Raleigh, North Carolina, for the five counties which lie wholly within the Chowan River Basin. Chowan County lies in the Albemarle Soil Conservation District, and the other four counties, Bertie, Gates, Hertford, and Northampton, are in the Roanoke-Chowan Soil Conservation District. Because of the manner in which soil conservation districts were originally orgarized, some districts include only one county, whereas other districts may contain as many as five counties.

The records of the State Conservationist are maintained on a district, and on a county, basis. Consequently, when a county lies partially in one basin and partly in another, it was necessary for the State Conservationist to use estimates instead of actual accomplishments in preparing the tables. He feels sure, however, that the figures indicated on the two tables are accurate enough for all practical purposes.

The large number of "remaining district cooperators", shown on the table of "Soil Conservation Practices Contemplated", does not necessarily signify an unwillingness on the part of farmers in those counties to carry out conservation plans. On the other hand, it simply means that the small number of Soil Conservation Service technicians available in North Carolina have been unable thus far to work with all of these farmers. The State Conservationist hopes to reach them all as rapidly as possible.

Watershed Protection and Flood Prevention-- As of September 16, 1955, the State Conservationist had received no applications from soil conservation districts, the areas of which include land in the Chowan River Basin, for planning assistance under the provisions of Public Law 566, 83rd Congress, 2nd Session, and little interest in the watershed protection program has been manifest in areas lying within the Basin.

SOIL CONSERVATION PRACTICES ACCOMPLISHED

| | Item | UNIT | BERTIE | CHOWAN | GATES | HERTFORD | NORTHAMPTON | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 4 | Closed drains | LF | 13,364 | 27,814 | 21,254 | 96,811 | 11,712 | 170,955 |
| 5 | Conservation crop rotation | Ac. | 4,410 | 3,193 | 2,940 | 4,642 | 5,265 | 20,450 |
| 6 | Contour farming | Ac. | 1,269 | 146 | 675 | 98 | 1,509 | 3,697 |
| 8 | Contour stripping | Ac. | 73 | 87 | --- | 2 | 20 | 182 |
| 9 | Cover Cropping | Ac. | 2,198 | 6,742 | 2,261 | 9,016 | 10,407 | 30,624 |
| 10 | Critical Area Planting | Ac. | ---- | ---- | ---- | ---- | ---- | ---- |
| 11 | Crop Residue Utilization | Ac. | 1,844 | 13,432 | 11,429 | 16,170 | 11,161 | 54,036 |
| 16 | Drainage | Ac. | 5,464 | 10,502 | 9,100 | 14,482 | 3,414 | 42,962 |
| 25 | Group Enterprise | Mi. | 4 | 7 | 12 | ---- | 6 | 29 |
| 25 | Group Enterprise | Cu.Yd. | 31,680 | 55,440 | 95,040 | ---- | 47,520 | 229,680 |
| 28 | Improvement Cuttings | Ac. | 3,108 | 1,620 | 2,608 | 215 | 2,484 | 10,035 |
| 32 | Open Drains | Mi. | 63 | 141 | 201 | 6 | 79 | 490 |
| 32 | Open Drains | Cu.Yd. | 315,000 | 705,000 | 1,005,000 | 30,000 | 395,000 | 2,450,000 |
| 33 | Pasture Planting | Ac. | 1,672 | 1,371 | 1,702 | 1,541 | 1,963 | 8,249 |
| 35 | Pond construction | No. | 11 | 21 | 4 | 35 | 15 | 86 |
| 42 | Sprinkler Irrigation Systems | No. | ---- | 8 | 1 | 4 | ---- | 13 |
| 42 | Sprinkler Irrigation Systems | Ac. | ---- | 360 | 1 | 149 | 28 | 538 |
| 47 | Terracing | Mi. | 22 | 2 | 1 | 49 | 73 | 147 |
| 48 | Tree Planting | Ac. | 33 | 56 | 3 | 42 | 66 | 200 |
| 49 | Waterway Development | Ac. | 27 | 5 | ---- | 17 | 39 | 88 |
| 50 | Wildlife Area Improvement | Ac. | 57 | 57 | 16 | 21 | 96 | 247 |
| | Now District Cooperators | No. | 250 | 456 | 361 | 625 | 369 | 2,061 |

SOIL CONSERVATION PRACTICES CONTEMPLATED

| | Item | Unit | Bertie | Chowan | Gates | Hertford | Northampton | Total |
|---|---|---|---|---|---|---|---|---|
| 4 | Closed drains | LF | 3,430,636 | 97,186 | 572,185 | 6,539,173 | 822,035 | 11,461,215 |
| 5 | Conservation crop rotation | Ac. | 25,599 | 42,086 | 33,432 | 45,849 | 52,907 | 199,873 |
| 6 | Contour Farming | Ac. | 11,324 | 304 | 7,100 | 10,098 | 25,260 | 54,086 |
| 8 | Contour stripping | Ac. | 2,097 | 113 | 925 | 2,618 | 1,746 | 7,499 |
| 9 | Cover Cropping | Ac. | 3,052 | 23,794 | 7,978 | 42,469 | 17,899 | 95,192 |
| 10 | Critical Area Planting | Ac. | ----- | ----- | --- | ----- | ----- | ----- |
| 11 | Crop Residue Utilization | Ac. | 28,178 | 21,568 | 24,944 | 35,315 | 17,013 | 127,018 |
| 16 | Drainage | Ac. | 14,818 | 17,058 | 10,571 | 7,256 | 19,015 | 68,718 |
| 25 | Group Enterprise | Mi. | 30 | 25 | 64 | 29 | 21 | 169 |
| 25 | Group Enterprise | Cu.Yd. | 237,600 | 198,000 | 506,880 | 229,680 | 166,320 | 1,338,480 |
| 28 | Improvement Cuttings | Ac. | 59,997 | 28,935 | 31,444 | 75,362 | 32,089 | 227,827 |
| 32 | Open Drains | Mi. | 287 | 431 | 260 | 129 | 478 | 1,585 |
| 32 | Open Drains | Cu.Yd. | 1,435,000 | 2,155,000 | 1,300,000 | 645,000 | 2,390,000 | 7,925,000 |
| 33 | Pasture planting | Ac. | 3,441 | 2,422 | 3,813 | 2,011 | 6,931 | 18,618 |
| 35 | Pond Construction | No. | 87 | 179 | 44 | 55 | 49 | 414 |
| 42 | Sprinkler Irrigation Systems | No. | 547 | 142 | 40 | 126 | 30 | 885 |
| 42 | Sprinkler Irrigation Systems | Ac. | 8,216 | 5,320 | 43 | 9,800 | 615 | 23,994 |
| 47 | Terracing | Mi. | 509 | 4 | 13 | 3,863 | 1,010 | 5,399 |
| 48 | Tree Planting | Ac. | 1,400 | 107 | 316 | 614 | 1,769 | 4,206 |
| 49 | Waterway Development | Ac. | 472 | 200 | 38 | 23 | 92 | 830 |
| 50 | Wildlife Area Improvement | Ac. | 231 | 41 | 48 | 26 | 95 | 441 |
| | Remaining District Cooperators | No. | 884 | 342 | 662 | 1,281 | 1,559 | 4,728 |

Survey in 1878--An act of Congress, approved June 18, 1878, directed that an examination or survey should be made of the Chowan River, North Carolina. The following is quoted from a report of Mr. W. G. Williamson, Assistant Engineer, to Captain Charles B. Phillips, District Engineer, U. S. Engineer Office, Norfolk, Virginia, dated January 20, 1879:

"CAPTAIN: I have the honor to submit the following report of the survey of that portion of the Chowan River known as 'Stumpy Reach', lying between the mouth of Bennett's Creek and Coleraine Landing.

The peculiar formations which give this part of the river its name, 'Stumpy Reach', consist of large submerged areas covered with stumps. That these surfaces were once above the water cannot be questioned. When they were submerged must be left to the geologist to determine. A knowledge of the length of time the stumps have been under the water would be very interesting to the engineer, as they are remarkably well preserved.

* * * * * * *

The difficulties presented by this 'Stumpy Reach' consist in steamers being unable to land at Woodleyville without running the risk of striking stumps, and also in having to run down the river nearly opposite Coleraine before steering for that landing, instead of running directly for the landing from Cedar Point or Armstrong's Wharf, the next landing above Coleraine on the east bank. The detour necessitates a run of 1,000 or 2,000 feet at most, longer than the direct line.

The first of these difficulties has been avoided by a wharf built just beyond the limits of the second stumpy area. The wharf was built by Dr. Woodley.

The second, as stated above, consists of an extra run of from 1,600 to 2,000 feet - a difference of five or six minutes' time. I confess I cannot see the propriety in the national government spending money to clear away obstructions which are such slight hindrances to navigation.

Sail-vessels experience greater difficulty in navigating the rivers than steamers. I am inclined to think very few sail-vessels, except, perhaps, small craft, navigate the river above Coleraine.

From the above description it does not appear that the commerce of the river justifies the great expense which the removal of the stumps would require. It would be advisable to have both the eastern and western channels marked by buoys, placed in such a manner as to indicate the position and extent of the stumpy areas, and at the same time define both channels, so that vessels wishing to use either would have no difficulty in doing so."

The following is quoted from a report of Captain Phillips to Brigadier General A. A. Humphreys, Chief of Engineers, U. S. Army, also dated January 20, 1879:

"On the 13th of August last, after having had an opportunity of visiting the river, I reported to you that the only obstructions to navigation occur at what is known as 'Stumpy Reach', from Bennett's Creek as low down as Coleraine Landing, a distance of about 7 miles. I also recommended that the survey be confined to this portion of the river. This recommendation having met with your approval, I intrusted the survey to a party in charge of Mr. W. G. Williamson, who was faithfully assisted by Messrs. Moncure and Blow.

The party undertook the work as soon as other surveys which were in hand could be completed. The work occupied from the 3d until the 13th of December last.

* * * * * *

The trade on the Chowan is of considerable importance, consisting principally in the shipments of large quantities of cotton, corn, wheat, tobacco, lumber, and fish.

Mr. Williamson was unable to obtain statistics showing the exact amount of the above-mentioned products shipped annually, but his report upon the survey of the Nottoway River, which is tributary to the Chowan, will give an idea of the large and fertile tract of country which seeks the Chowan as an outlet. The Blackwater, another tributary, has a constantly-increasing trade, which also finds an outlet by way of the Chowan. The Blackwater is now being improved by the United States Government, an appropriation for the purpose having been made by Congress in June last.

Four steamers run regularly upon the Chowan: two from Franklin, on the Blackwater, to Plymouth, N. C.; one from Franklin to Norfolk; and one from the same point to Murfreesborough, on the Chowan (Meherrin).

Besides these regular steamers, a number of others make ocassional trips, principally for the purpose of towing rafts of timber and to transport fish during the season.

Attention is called to the fact that the commerce of the Chowan River and its tributaries is carried on almost exclusively by steamers; and it is not probable that any improvement of 'Stumpy Reach' would materially increase the use of sailing vessels, as the river becomes so narrow above, and as the navigation of its tributaries is absolutely impracticable except by means of warping.

Steamers have no trouble in navigating 'Stumpy Reach'. A well-defined channel, of ample width and depth, exists over this whole section of the river. The removal of about one-half of the stumps, as suggested by Mr. Williamson, would shorten somewhat the distance that steamers are obliged to run in order to make their regular landings at this part of the river. In no case, however, would this saving in distance exceed one-half mile. Should any attempt be made to clear 'Stumpy Reach', I do not see that any less can be done than that proposed in the plan of Mr. Williamson.

I cannot believe that the slight saving in distances that would be effected by this plan would compensate for the outlay, according to the

accompanying estimate amounting to $81,450.

Mr. Williamson's recommendation in regard to the buoying of the channel on each side of Holliday's Island is a good one. I join with him in his recommendation, and would suggest that the attention of the proper department be called to the matter.

The Chowan River is in the collection-district of Edenton.

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers."

House Document No.1114, 62d Congress, 3d Session--This publication contains the reports of the District Engineer, Norfolk District, dated December 21, 1911; the Division Engineer, Southeast Division, December 27, 1911; the Board of Engineers for Rivers and Harbors, dated January 22, 1912; and the Chief of Engineers, War Department, dated October 31, 1912, on preliminary examination of Chowan River, N. C., in accordance with the provisions of the act of Congress approved February 27, 1911, "making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes".

The following is quoted from the report of the District Engineer:

"The Albemarle Steam Navigation Company operates two steamers continuously upon this river, connecting with the Norfolk Southern Railroad at Edenton, N. C., with the Atlantic Coast Line Railroad at Tunis, N. C., and with the Southern Railway and the Seaboard Air Line Railway at Franklin, Virginia. While crops are being moved, additional boats are used. Besides the above, several lumber companies tow logs along the river, and occasionally sailboats and motorboats ply on this stream.

The total tonnage on this river during the calendar year 1910, as compiled by Mr. J. A. Pretlow, general manager of the Albemarle Steam Navigation Company, was 18,306 tons, valued at $2,141,318, and 12,000 passengers were carried.

It is evident that there is considerable water-borne commerce on this stream, but it is also evident that the channel width and depth are ample for the present commerce and for the prospective commerce for some years to come. There are no obstructions in the channel and the navigation of the river is quite easy, except at one point, some 25 miles from its head, where there is a portion of the stream called Stumpy Reach. Here, for some distance bordering the channel, there are considerable areas upon which there are numerous submerged stumps, but even through this reach the channel is of ample width and depth.

Numerous inquiries were made, orally and by letter, of persons known to be interested in the navigation of Chowan River, and none of the replies advocated any improvement whatever of this stream, except the better lighting of Stumpy reach. No investigation was made of the necessity for additional lights, as this is the province of another department.

In view of the above facts, I am of the opinion that the Chowan River is not, at present, worthy of improvement by the United States.

No questions of water power are involved in any possible improvement of this stream.

At Edenton, N. C., where steamers navigating the lower portion of the Chowan River land, there is a public wharf, at which terminal facilities are extended to all on equal terms. At all other landings on the river, the wharves and landing facilities are owned or controlled by private parties, but it is not known upon what terms their facilities are extended.

There are no mechanical appliances for handling freight at any of the public or private wharves."

The Division Engineer, the Board of Engineers for Rivers and Harbors, and the Chief of Engineers, concurred in the opinion of the District Engineer that the improvement by the United States of Chowan River, N. C., was not deemed advisable at that time.

House Document No. 101, 76th Congress, 1st Session--This publication contains the reports of the District Engineer, Norfolk District, dated June 9, 1938; the Division Engineer, South Atlantic Division, dated June 17, 1938; the Board of Engineers for Rivers and Harbors, dated September 26, 1938; and the Chief of Engineers, War Department, dated October 19, 1938, pursuant to resolutions, adopted by the Committee on Rivers and Harbors of the House of Representatives on January 14, 1936 and requesting the Board of Engineers to review the reports on Chowan River, N. C. submitted in House Document No. 1114, and the reports on Blackwater Creek, Virginia, submitted in House Document No. 177, 59th Congress, 2nd Session, with a view to determining whether it was advisable to improve this waterway in the interests of commerce at that time.

The following is quoted from the report of the District Engineer:

"The Albemarle Navigation Company owns wharves and warehouses on Chowan River at Mount Gould, Colerain, Mount Pleasant, and Winton, N. C. In the past seven years, however, these terminals have been little used. The Standard Oil Company operates wharves at Winton and Colerain, and the Sinclair Refining Company operates a wharf at Winton. At Tunis, N. C., the Atlantic Coast Line Railroad operates a large wharf and warehouse. This is the only point on the Chowan River where connection between water and rail exists. The Norfolk, Baltimore & Carolina Line, a boat line, operates a wharf and warehouse at Colerain, at which point there are two other private wharves, on one of which is a warehouse. With exception of the oil wharves, all the wharves on the river are open to the public on equal terms. On the Chowan River, between the mouth of the Meherrin River and the confluence of the Nottoway and Blackwater Rivers, there are four landings and two wharves, all of which have been abandoned and are in dilapidated condition. One crude landing in this 12-mile stretch is being used for loading logs. Additional terminal facilities on Chowan River would not be required in connection with the proposed improvement.

* * * * * *

Although Chowan River is not under improvement by the United States, considerable commerce moves on the waterway. The tonnage carried and its value since 1931 are as follows:

| Year | Tons | Value |
|---|---|---|
| 1931 | 7,348 | $244,418 |
| 1932 | 30,544 | 664,966 |
| 1933 | 21,233 | 631,590 |
| 1934 | 37,184 | 684,927 |
| 1935 | 55,143 | 1,107,144 |
| 1936 | 84,984 | 1,298,482 |
| 1937 | 92,636 | 1,528,271 |

Through traffic on the river, or the commerce to and from points on Meherrin River and Bennett Creek, amounted to 52 per cent of the total commerce reported for the river in the calendar year 1937. With the exception of 1933, commerce has increased yearly in the seven years of record. Rafting on the stream has been occasional, and none was reported for 1937. Since 1933, 1,440 tons of logs were carried on Blackwater River, no commerce has been reported for that section of Chowan River (and its tributaries) above the mouth of Meherrin River. Inbound commerce on Chowan River for 1937 consisted principally of petroleum products, fertilizer, and package freight, and outbound commerce consisted of logs, lumber, and piling.

* * * * * *

In 1937, petroleum products were carried on Chowan River by 7 motor tankers, with standard full load drafts of from 6 to 10 feet, and making collectively 89 round trips during the year. Forest products and fertilizer were carried on barges and sailing vessels having standard full-load drafts of from 5 to 11 feet. One regular line used the river during the year, operating one motorboat with a full-load draft of 9½ feet, and made 91 round trips, and one steamer with a full-load draft of 10 feet made 75 round trips. There was a total of 596 round trips made by all vessels using the river during 1937."

The District Engineer stated in his report that local interests desired a channel 12 feet deep in Chowan River, N. C., from its mouth to the confluence of the Nottoway and Blackwater Rivers, a distance of 52 miles, and the same depth in Blackwater River from its mouth to Franklin, Virginia, a distance of 14.7 miles, suitable for the navigation of the type of barges ordinarily used in the Intracoastal Waterway trade.

He found that the two waterways were being utilized in their condition at that time for transporting pulpwood and timber to the industries at Franklin, and shipments of lumber from that point, but that sharp bends and the inadequacy of the channels existing at that time prevented the use of the waterways for the navigation of large barges.

He concluded that the substantial, tangible savings, which could be effected by the diversion from rail to water of a portion of the shipments of manufactured products from Franklin to northern points, economically justified the desired improvement.

He believed, however, that local interests should be required to furnish certain items of cooperation.

He recommended (1) that a project be adopted for Chowan River, N. C. to provide a channel 12 feet deep and 80 feet wide throughout its entire length, including a cut-off channel of like dimensions through a sharp bend near Riddicksville, N. C., in Hertford County about 1.5 miles south of the North Carolina-Virginia State Line, at an estimated first cost of $15,000, with $500 annually for maintenance; and (2) that the existing project for Blackwater River, Va., be modified to provide for a channel, 12 feet deep and generally 80 feet wide, from the mouth to Franklin, including cut-off channels through two bends near Cherry Grove and Georges Bend, and a turning basin of 3.2 acres at the head of the improvement, at an estimated first cost of $120,000, with $3,500 annually for maintenance.

He also recommended that no work be undertaken by the United States until local interests (1) shall have constructed additional terminals at Franklin suitable for the mooring of large barges and for the efficient transfer of cargoes to and from large barges, (2) shall have furnished, free of cost to the United States, suitable spoil-disposal areas for the initial improvements and for subsequent maintenance when required, and (3) shall have furnished, free of cost to the United States, such lands and rights-of-way as might be required for the construction and maintenance of the turning basin and the cut-off channels in the two waterways.

The Chief of Engineers, after full consideration of the reports of the District and Division Engineers and the Board of Engineers for Rivers and Harbors, recommended the improvement of the Chowan and Blackwater Rivers as recommended by the District Engineer, except for some modification of the terms of local cooperation.

Existing Project--The following is quoted from "Water Resources Development by the Corps of Engineers in North Carolina, Corps of Engineers, U. S. Army - Office of the Division Engineer, South Atlantic Division - Atlanta, Georgia, 1 January 1955:

PROJECTS COMPLETED

NAVIGATION ( CHANNELS AND HARBORS)

LIGHT-DRAFT CHANNELS

* * * * * *

MEHERRIN RIVER

This waterway extends northwesterly, from the mouth at the Chowan River about 39 miles above Albemarle Sound, to a turning basin above the highway bridge at Murfreesboro, a distance of about 10.5 miles. The present approved project provides for a channel, 10 feet deep and 100 feet wide, except for a channel 80 feet wide through a cutoff at Devil's Elbow, 4 miles above the mouth; and a turning basin of the same depth, 300 feet wide and 500 feet long, at Murfreesboro. The project was completed in 1938 at a cost of about $47,700.

The average annual tonnage of commodities, principally petroleum and pulpwood, transported over this waterway during the period 1949-1953, amounted to about 8,000 tons. In 1953, commerce totaled about 9,400 tons.

* * * * * *

## OTHER AUTHORIZED PROJECTS

### NAVIGATION ( CHANNELS AND HARBORS)

### LIGHT-DRAFT CHANNELS

### CHOWAN RIVER

Chowan River, formed by the confluence of the Nottoway and Blackwater River at the Virginia-North Carolina State Line, flows south 52 miles into the west end of Albemarle Sound, 4 miles west of Edenton. The project provides for a channel 12 feet deep and 80 feet wide from the mouth to the confluence of the Nottoway and Blackwater Rivers, about 1 mile below the confluence.

No work has been done on the project; the estimated cost is $30,000.

Average annual commerce over this waterway was about 65,800 tons in the period 1949-1953, consisting almost entirely of pulpwood, petroleum products, and fish. In 1953 commerce totaled about 56,100 tons.

* * * * * *

### PRELIMINARY EXAMINATIONS AND SURVEYS UNDER WAY

Many of the following reports have indefinite dates of completion, either because funds have not been appropriated or the available funds are insufficient. Generally, unless the present urgency of an investigation has been established, funds are not available at this time.

| LOCALITY | PURPOSE | APPROXIMATE DATE TO BE COMPLETED |
|---|---|---|
| * * | * * | * * |
| Chowan River Basin, Va. and N. C. | To investigate the advisability of providing flood control and major drainage improvements | Indefinite |
| * * | * * | * * |

The following is quoted from "Water Resources Development by the Corps of Engineers in Virginia, North Atlantic Division, Corps of Engineers, U. S. Army, 1 January 1955:

### OTHER AUTHORIZED PROJECTS

Listed in this category are:

(1) Projects on which no work has been accomplished, and which will be restudied prior to request for funds for construction, and

(2) Projects which are partially completed, but on which further work is considered not warranted at this time.

* * * * * *

BLACKWATER RIVER - NORFOLK DISTRICT

This river rises in Prince George County near Petersburg, Va., and flows in a general southeasterly direction for 80 miles, where it unites with the Nottoway River to form the Chowan River, which, in turn, empties into Albemarle Sound, N. C. The lower section of Blackwater River, extending from the mouth upstream to Franklin, a distance of 13 miles, is under Federal improvement.

The existing project provides for a channel, 12 feet deep and generally 80 feet wide, from the mouth to a point just downstream from the Seaboard Air Line Railroad Bridge at Franklin, a distance of 14.5 miles, including cutoff channels of equal dimensions through bends at Cherry Grove and Georges Bend and a turning basin of 3.2 miles at Franklin. The project further provides for clearing the river below Franklin of obstructions to afford easy navigation for boats of 7 feet draft. The project is about 5 per cent complete, with only $22,044 having been expended toward its construction. The latest Government cost for completing the project is $302,500.

The average annual commerce for the period 1944-1953 was 32,676 tons, consisting entirely of pulpwood carried by barges. During the year 1953, a total of 18,972 tons of pulpwood were reported.

Completion of the project to provide a 12-foot depth to Franklin was authorized to permit a partial diversion to water haul on large barges of pulpwood, board, and processed lumber via the Intracoastal Waterway. However, the railroads serving that area applied for and were granted a reduction in freight rates for these commodities, approximately on a parity with the proposed barge rates. Consequently there has been no recent demand for completion of the project."

## CHAPTER XII--POTENTIAL FUTURE DEVELOPMENT

The potential future development of the four sections of the Chowan River Basins, information concerning which is contained in preceding chapters, is set forth below.

N. C.-Virginia State Line to Mouth of Meherrin River-- This area has possibilities of further agricultural and some industrial development. The waters should, in general, be protected for fish and wildlife, agriculture, and recreational uses including hunting and camping. The increased use of water for irrigation is a possibility.

Mouth of Meherrin River to A. C. L. Railroad Bridge across Chowan River near Tunis-- This area has possibilities of further agricultural development and some industrial growth connected with the lumbering and fishing industries. If the waters in this area are protected from pollution, the Chowan River therein can be further developed for recreational activities.

A. C. L. Railroad Bridge across Chowan River near Tunis to Mouth of Chowan River, excluding Beaches--This area has possibilities of further agricultural and industrial development. Increased use of water for irrigation is indicated throughout this area. The waters should, in general, be protected for fish and wildlife, agriculture, and recreational uses including bathing and camping.

Mouth of Chowan River, including Edenton Bay and Adjacent Waters, to a Line extending from the Mouth of Blackwater Swamp, Bertie County, to the North End of Norfolk-Southern Railroad Bridge across Albemarle Sound--This area is probably the best section of the Basin within North Carolina for future industrial development because of the available labor supply in and around the town of Edenton, and its ease of accessibility by land or by water.

This area also has possibilities of further agricultural development, especially as pertains to truck farming. Increased use of water for irrigation is indicated throughout the area.

If the waters are protected from pollution, Edenton Bay can be developed for recreational purposes.